LAND USE COMPATIBILITY STUDY

June 1980

Ontario
Ministry of the Environment

LAND USE COMPATIBILITY STUDY:

Interpretation of MOE Complaint Data For Land Use Planning

Compiled by:

Ian Veitch (Supervisor)
Craig Milne
Kim Warburton

For the Land Use Co-ordination & Special Studies Section, Environmental Approvals Branch, Ministry of the Environment (MOE) under the Ministry's Experience '79 Program

June 1980

ACKNOWLEDGEMENTS

There were many individuals contacted during the summer of 1979, both inside and outside the Ontario Government, whose kind co-operation made this study possible.

All the managers, officers and enviornmental engineers and inspectors contacted in the Ministry of the Environment's Central Region, and Toronto and Oakville District Offices who are involved in Industrial and Municipal and Private Abatement functions deserve special mention. We are also very grateful to all the plant operators in the private and public sector who very graciously allowed us to tour their industrial or utility operations and provided invaluable, first-hand information.

Appreciation is due to Mr. M. E. Plewes, Section Supervisor and Mr. B. R. Ward, Unit Head, in the Land Use Co-ordination and Special Studies Section, Environmental Approvals Branch for their support and insight offerred from the start to the conclusion of the project. A note of thanks also to the study's three internal Ministry advisors: Mr. Don Pirie, Chief, Planning and Approvals, Central Region; Dr. Les Foster, Program Planning and Evaluation Branch; and, Dr. John Hewings, Criteria Development and Program Planning Section, Air Resources Branch.

Finally, a thank you to the secretarial staff in the Environmental Approvals Branch, who typed several versions of the document and assisted in its layout.

ABSTRACT

Complaint data from the MOE's Files in the Central Region of problematic sources of air pollution was analyzed to determine if and how it is useful in substantiating measures that can be used in land use planning for maintaining the compatibility between land uses.

Adverse environmental effects, mainly odours, were analyzed from the point of view of sources of emission, transmission of contaminants and characteristics of the receptors for residential uses affected by: petroleum refineries; meat packing houses; rendering operations; sewage treatment plants; a garbage transfer station; and, a landfill site. The complaint data was supplemented by site visits, in some cases meteorological data on wind direction, socio-economic data from Statistics Canada, and mapping of complaint locations on municipal base maps to determine source-receptor distances.

The results of complaint analysis were concluded to be a potentially useful tool for land use planning. It provided a quantitative indication of adverse environmental effects that could be expected from an incompatible land use. Its most important application is in the determination of separation distances between emission sources and receptors. Complaint data is most useful for application when it has been collected from easily identifiable sources of emission having large numbers of complaints occurring in several directions around them. This occurs, for example, where oil refineries, on the north shore of Lake Ontario, have residential areas situated in proximity to them.

The method of complaint analysis still requires refinement. For instance, the number of complaints received should be compared with the population density in the affected areas.

CONTENTS

LIST OF ILLUSTRATIONS

CHAPTER 1

INTRODUCTION

The compatibility of one land use with another is a complex relationship. There are many factors that influence adverse environmental conditions occurring between land uses, which can periodically expose nearby persons to odours, particulates and other fugitive, air-borne contaminants. These elements range from those influencing the source and transmission of unpleasant emissions, such as the kind of industrial process used and climatological conditions, to those pertaining to the receptor, such as the type of land use affected and the personal and socio-economic characteristics of nearby residents.

Land use planning can be utilized in order to avoid incompatibility in land use by controlling several of the variables causing periodic adverse environmental conditions. Land use planning can, for example, specify the siting of emission sources and sensitive land uses appropriate distances and directions away from one another. It can also influence the types of intervening land uses, population density of receptors, people's awareness of possible nuisance conditions, and to some extent, landscaping. However, the Ministry of the Environment's recommended separation distances, buffers and other control measures recommended for proposed changes in land use are not well documented by analytical studies, and it is therefore sometimes difficult to achieve the Ministry's objectives.

The purpose of this study is to examine the usefulness of MOE complaint data to land use planning: that is, assessing if and how complaint data can provide factual and quantitative information to substantiate planning control measures that maintain land use compatibility.

CHAPTER 2

METHOD

The method generally involved the collection and analysis of complaint data compiled over the last five years in the Ministry's Regional or District Files for those land uses selected as problematic sources of periodic air emissions. The complaint data was assessed for its usefulness to land use planning, by comparing it with several factors that could substantiate land use planning control measures. The main factor examined quantitatively was source-receptor distance, and to a lesser extent prevailing wind direction. Population density, topography and landscape, and socio-economic factors were only described for those land uses selected as there was insufficient information available for quantitative analyses or correlations of these factors.

A. Procedures and Data Sources

The method used in the study can be summarized as proceeding through the several stages.

1. Selection of air pollution source in consultation with MOE Planning and Approvals Chief and MOE Abatement Engineer.

The land uses investigated in MOE's Central Region as emission sources of air pollution included:

- three petroleum refineries (Shell Oil - BP, Gulf Oil);
- several meat packing houses (Canada Packers, Swifts);
- two rendering operations (Gordon Young, and Darling & Co. Ltd.);
- two sewage treatment plants (Ashbridges Bay & Highland Creek);
- one garbage transfer station (Victoria Park & McNichol Avenues);
- one landfill site (Beare Road).

2. Identification of the physical process for industrial/ utility operations, their basic pollution control measures, kind of odour or other adverse environmental effects, and when and where adverse conditions occur through discussion/meeting with appropriate MOE abatement inspector and perhaps plant operator.

3. Analysis of MOE Regional or District Abatement Files for selected operations over a 5 year period (after authorization by District Officer) by recording data for all complaints received for each pollution source on a summary form. Data recorded from each complaint form and summarized for each pollution source included:

   (a) type of complaint (odours, smoke, etc.)
   (b) number of complaints
   (c) distance from source (address of complainant)
   (d) time of complaint (hour, day, season, year).

4. Mapping of complaint locations around each pollution source (and frequency of complaints for each one) on base map obtained from local municipal planning office, sufficiently detailed to have street names (and numbers) on it.

5. Calculation of source-receptor distances by measuring distances with a scale. Numbers of complaints were expressed for various radial distances (in kilometers) away from the pollution source (i.e. percentages of total complaints received 1, 2, 3 and 4 kilometers away from the source).

6. Site Visit to:

   (a) air pollution source - to examine locations of equipment involved in industrial/utility process and pollution control devices, and locations of sources of specific and fugitive emissions;
   (b) intervening lands - to examine existing land cover and uses;
   (c) receptors - to examine physical and socio-economic characteristics of the affected areas and to verify some complainant's addresses.

   Photographs were taken to illustrate site features and conditions in relation to emission sources.

7. Information on wind direction and wind speed (recorded at an intermediate height) was obtained on computer print-outs from MOE's Air Resources Branch, from the monitoring station(s) located close to the areas experiencing complaints which recorded during recent complaint episodes.

8. A 360^{o} radial scale was plotted to indicate percentage of time (averaged over 5 years) winds (over approx. 5 km/hr) blew from various directions to determine if source-receptor directions in high complaint areas compared well with prevailing wind direction.

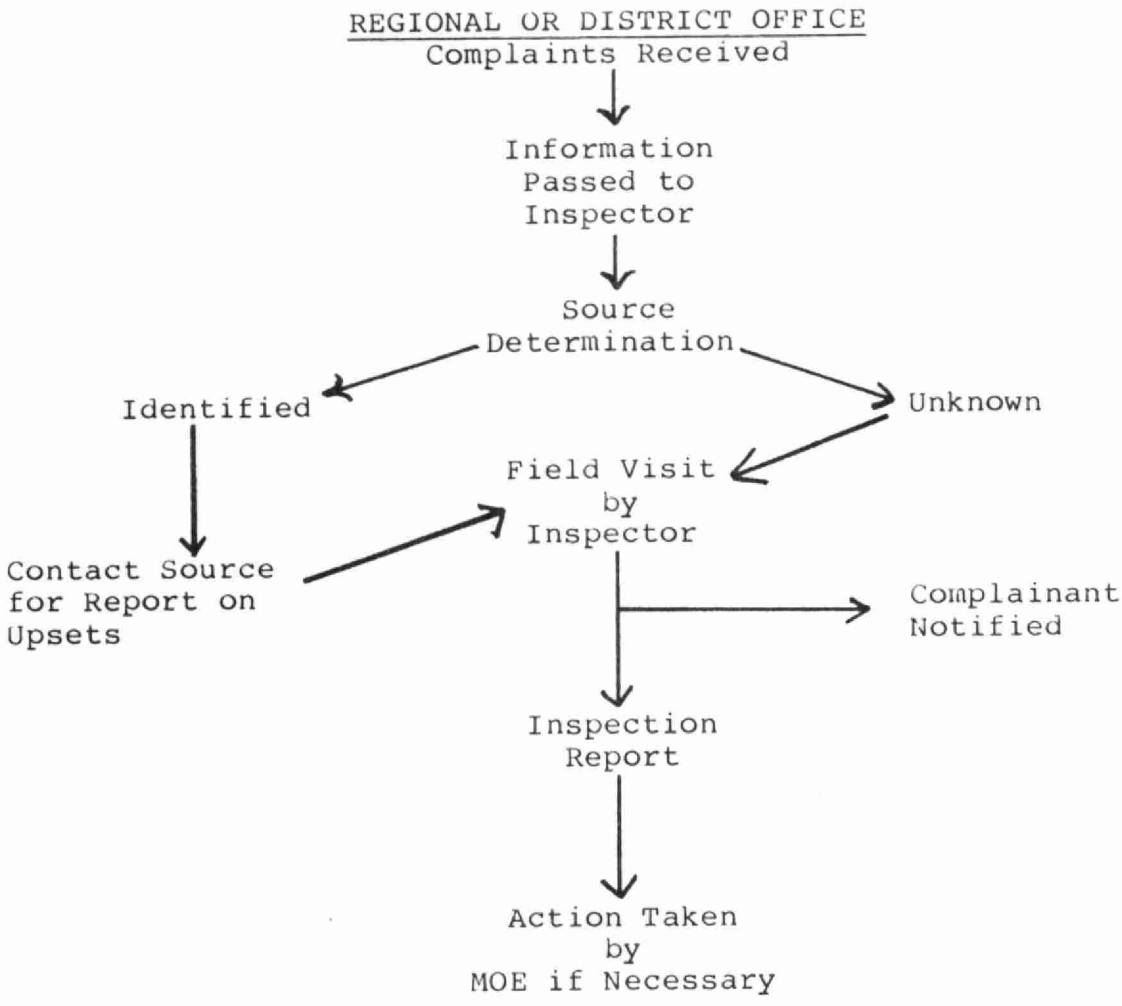
9. General socio-economic data (e.g. ethnicity, population density) was collected from Statistics Canada's census tracts that were recorded through residential complaint areas. It was described and compared for each pollution source in relation to the complaint levels.

10. A report was written for each of the pollution sources selected to determine if, how and why the relevant complaint data was useful in substantiating planning measures for avoiding land use conflicts. A similar format was used for each report write-up, the length depending upon the obvious importance of the complaint data in each situation and the availability of information.

11. An annotated bibliography was started for:

    (a) odours and complaint data in general; and
    (b) for those problematic air pollution sources selected (e.g. refineries, rendering plants) having specific environmental problems and control measures.

The main data source was the complaint data filed by the Regional and District Offices of MOE. A brief description of the procedures followed in the handling of public complaints is as follows:



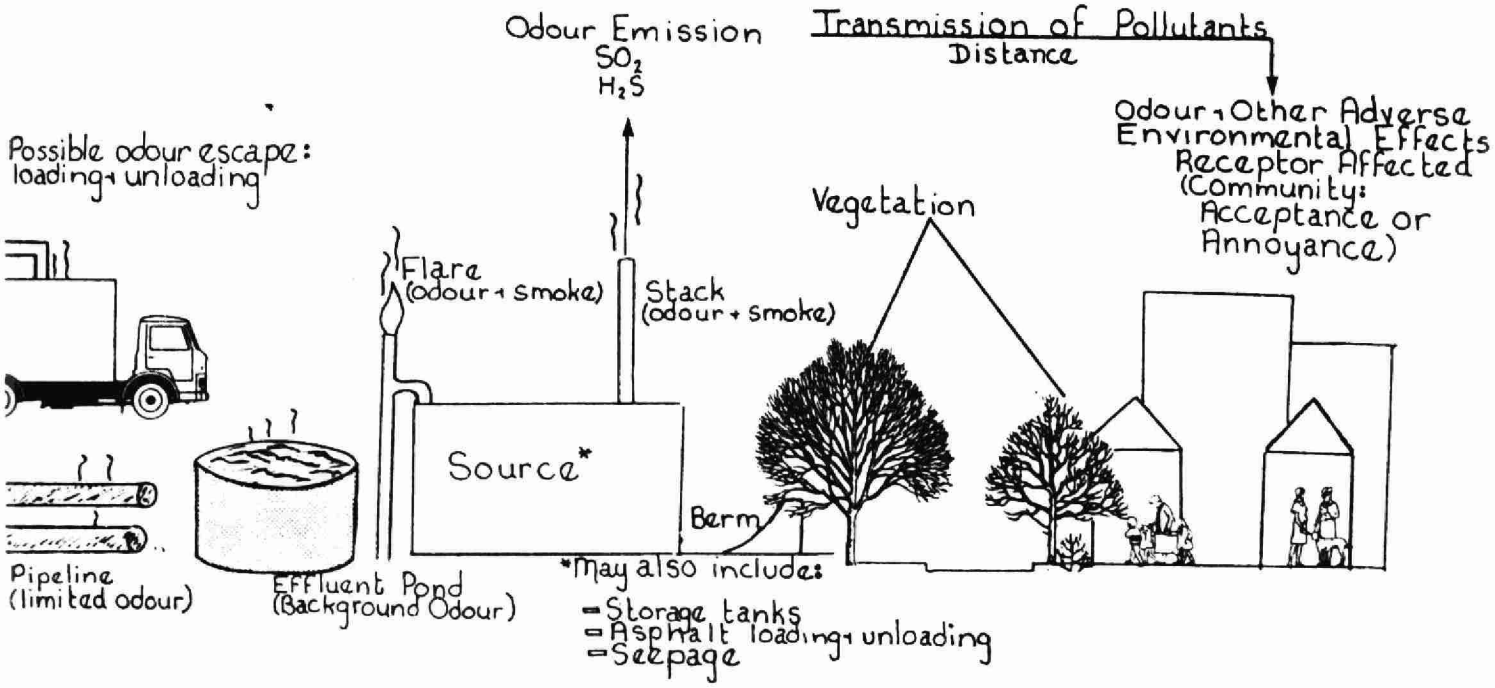
Data sources used to supplement information in complaint files can be summarized as follows:

- site visits
- plant personnel
- Industrial Abatement Inspectors, MOE
- Air Management Personnel, MOE
- Atmospheric Environment Service, Environment Canada
- Statistics Canada
- municipal planning offices (maps)
- additional readings.

B. Factors Affecting Land Use Compatibility

The approach taken in data collection and analysis recognized three sets of variables involved in land use compatibility: source of emission, transmission of contaminants and characteristics of receptors. Figure 1, below, generally illustates these variables for a land use conflict between an oil refinery and a residential area.

Figure 1 : Illustration of variables involved in Land Use Compatibility: Petroleum Refinery / Residences



1. Source of Emission

The first set of factors relate to the Source of Emission. Where an industry emits an annoying odour, for example, the impacts of the odour in terms of its quality, intensity, frequency and duration are determined in part by the following factors:

a) inputs to the process (raw materials, solid waste, animal protein)
b) nature of the process (distillation, incineration, storage)
c) products and by-products produced and emitted
d) pollution control equipment employed
e) transportation and handling of raw materials, products and wastes
f) scheduling of process.

2. Transmission of Contaminants

The second set of important factors relate to transmission of pollutants. In order to constitute a nuisance, a pollutant must be seen, heard, or otherwise detected at some point removed from the site of emission. Factors which may influence the direction, rate and magnitude of spread include the following:

(a) physical features of the intervening landscape

i) topography
ii) vegetation and buildings
iii) distance between source and receptor.

(b) climatological conditions

i) wind velocity (direction & speed)
ii) temperature
iii) humidity
iv) air pollution index.

3. Characteristics of Receptors

Once a pollutant reaches a receptor, many factors are involved in determining the degree of impact upon that receptor. Since we are considering land use compatibility here, the receptor can

be considered to be a land use. Land use refers to any structural characteristics of the natural or built biophysical environment and any activities usually humans which occur there. Factors associated with receptors include the following:

a) nature of land use (type, density, sensitivity)
b) intensity of land use (degree of activity)
c) physical characteristics of impacted site
d) nature of occupancy (home or work, length of stay)
e) time factors
f) perception of pollutants

    i) awareness of complaint procedures
    ii) previous experience with this type of problem
    iii) individual tolerance (physiological, psychological and sociological implications).

Although all the above factors affecting land use compatibility were considered in analyzing the complaints resulting from the air pollution sources examined, only source-receptor distance, and to a limited extent wind direction, were assessed quantitatively for their usefulness to land use planning.

CHAPTER 3

OBSERVATIONS AND DISCUSSION

A. Refineries

1. Introduction

Odour, smoke, and particulate emission complaints continue to indicate concern by individuals residing close to petroleum refineries. Such emissions are certainly considered to be a nuisance by many residents in the area and could result in adverse health effects to some. This section will analyze the number and type of complaints associated with petroleum refineries and residential areas. Variables involved in land use compatibility will be identified and complaint data assessed for its application to land use planning.

Three refineries were studied in the Mississauga/Oakville region. These include Gulf (in Clarkson area of Mississauga), and Shell/BP (Oakville). For the purpose of this study Shell and BP will be regarded as one industry, because of their close location and combined use of a sulphur plant.

2. Sources of Emission

a) Refinery Operations

Refining of crude oil involves the separation of hydrocarbon groups through fractional distillation, catalytic 'cracking' of the larger molecules to smaller hydrocarbon chains, and purification processes, such as hydrogen desulfurization.

Each of these processes produces desired products, but also results in the production of waste by-products which must be disposed of, generally through incineration. Any disfunction of pollution control equipment may result in emissions of compounds such as sulfur dioxide (SO_2), and hydrogen sulfide (H_2S) into the atmosphere. Such compounds often produce annoying, unpleasant odours and may occasionally have damaging effects upon vegetation or even human health.

b) Odour Sources

(i) GULF

The refinery was constructed in 1943, (during WWII) with later additions, and produces a wide range of petroleum products, from the lighter gasoline products to lubricating oils, greases and asphalts. The facilities required for the production of such a wide range of products make this refinery more 'complex' than those which produce a more limited range of products.

Due to the complexity of such an operation, many potential sources of odour emission are present. These discharges include leakage around pump seals, from the tank field, catalytic cracker, desulphurization unit, and from the effluent treatment ponds. Location of these sources are illustrated in Figures 1a and b. Despite recent expenditures on pollution control equipment, emissions will always occur. There are many reasons for the occurrence of such emissions ranging from equipment breakdown to continuous "background" odours. When climatic and other conditions are appropriate, unpleasant odours can be expected to carry into nearby areas.

(ii) SHELL/BP

Odour sources from these refineries are varied. Both share a sulphur plant, which emits an H_2S odour. Such an emission is affected by atmospheric stability, and creates the refineries' greatest source of complaints.

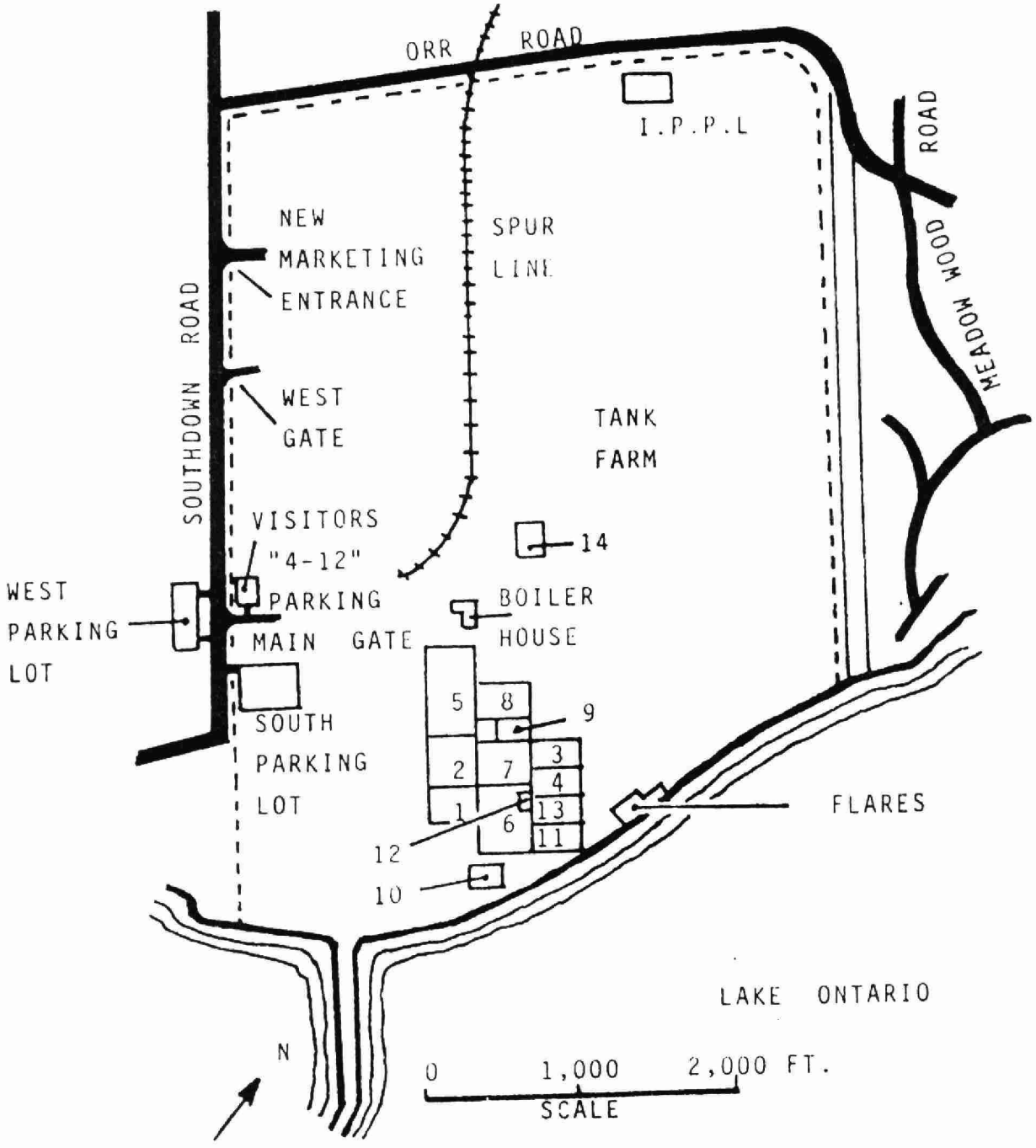
Further emission sources which generate fewer complaints include: effluent treatment ponds, storage tanks, and Shell's oxidized asphalt operation (BP's is non-oxidized). Breakdowns such as catcracker malfunctions create occasional odour and smoke related problems.

As is the case with Gulf, despite pollution control equipment, odours can always be expected to drift into nearby residential areas under certain conditions.

c) Pollution Control Equipment

In order to reduce odour problems, various anti-pollution measures have been employed by the refineries. These measures are not common to all three operations, however they do indicate various steps that can be undertaken (modified list based upon Shell's paper on Pollution Control Facilities).

FIG. 1A : CLARKSON REFINERY UNIT PLOT PLAN

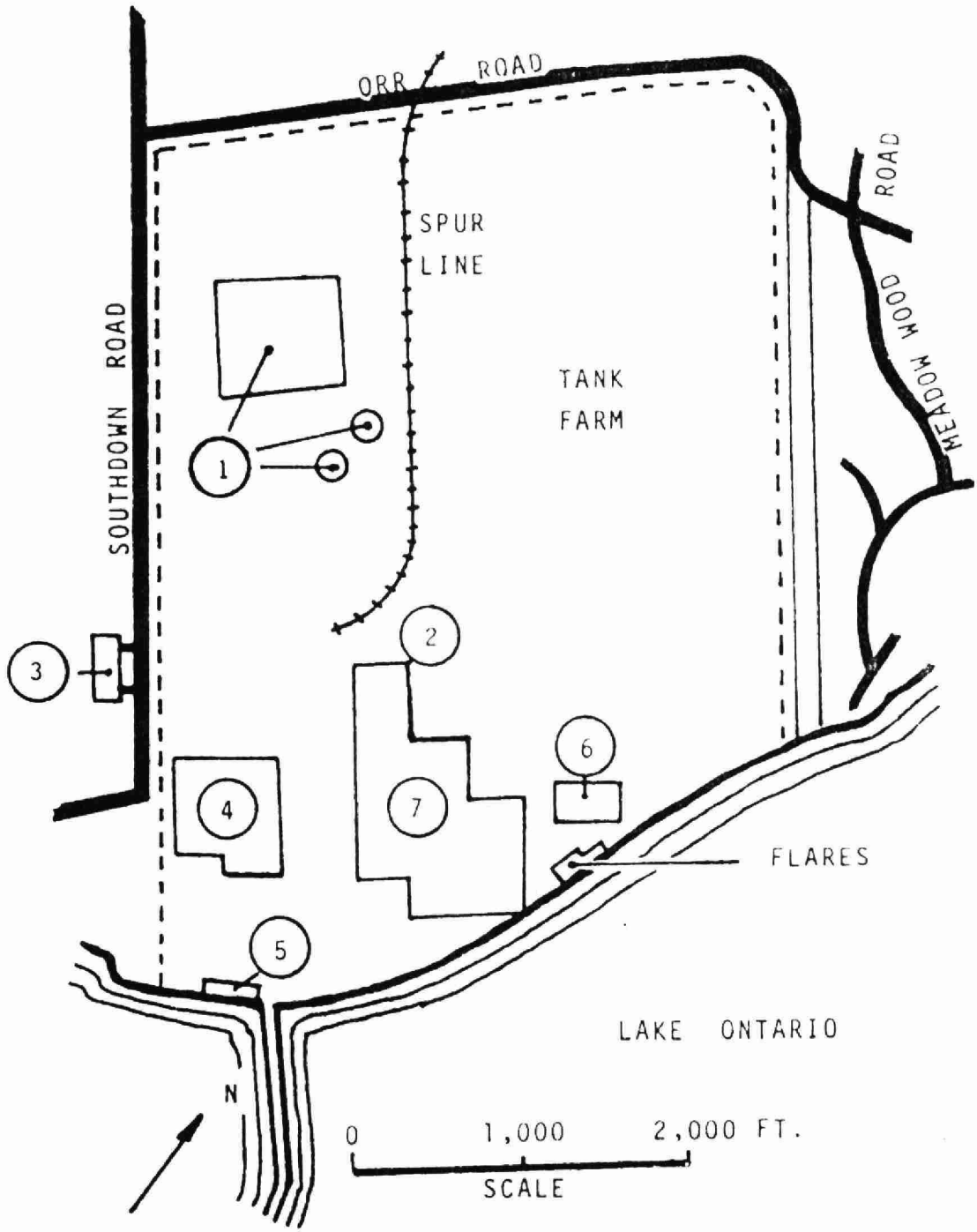


LEGEND

1. NO. 1 CRUDE
2. NO. 2 CRUDE
3. NO. 3 CRUDE
4. CONDENSATE
5. LUBE PLANT
6. F.C.C.U.
7. REFORMER
8. HYDROBON
9. DISTILLATE DESULFURIZER
10. SULFUR PLANT
11. ALKYLATION
12. POLYMERIZATION
13. SATURATE GAS PLANT
14. ASPHALT PLANT

FIG. 1B : CLARKSON REFINERY — LUBE PLANT MODERNIZATION

SITE LOCATION



LEGEND

1. PROPOSED TANKS
2. PROPOSED BOILER STACK
3. CONSTRUCTION PARKING
4. PROPOSED LUBE PLANT
5. PROPOSED COOLING TOWERS
6. FUTURE STORM WATER POND
7. EXISTING UNITS

Possible Source of Pollutants	Anti-Pollution Measures
1. Storage Tanks	Floating roofs on all crude oil storage tanks.
2. High Stacks	All heater, boiler and incinerator flue gases are put to atmosphere via two 300 (BP-400) foot high stacks.
3. CCU Catalyst Dust Control and CO Heater	Any catalyst remaining in the CCU flue gas is dispersed via the high stacks. CO emissions to atmosphere are eliminated by burning the CO in the crude heater.
4. Sulphur Recovery Unit (SRU)	Sulphur removed from products converted to elemental sulphur and sold as a by-product. Sour gases are burned in a heater during SRU shutdown. Flue gases are directed to a high stack.
5. Flare	3 stage shielded smokeless ground level flare. Light emissions are minimal.
6. Sour Water Handling	Sour waters containing H2S, ammonia, and mercaptans are collected in a closed system.
7. Effluent Treatment Plant	Consists of: - equalizing ponds - air floatation unit - activated sludge biological treatment - polishing aeration and equalization.

d) Transportation

The products of all three refineries are transported to other locations in Canada and the U.S.A. Methods of transportation include truck, ship, and pipeline which operate on a continual basis. Each mode to a small degree may create an odour problem. However, complaints concerning such a factor are extremely low.

e) Process Scheduling

The three refineries are for the most part, continually operating. With the exception of breakdowns, shutdowns or decreases in production due to over supply, the refineries operate 24 hours a day, seven days a week. Therefore, odour-related problems cannot be specifically confined to one particular period.

f) Summary

Having identified many of the emission sources, a clearer picture of how surrounding land uses may be affected by odour has been obtained. Residential areas are often the recipients of these problems. However other variables exist which have a direct or indirect impact upon refinery emisions, and ultimately surrounding land uses. Some of these factors will be examined in the following section.

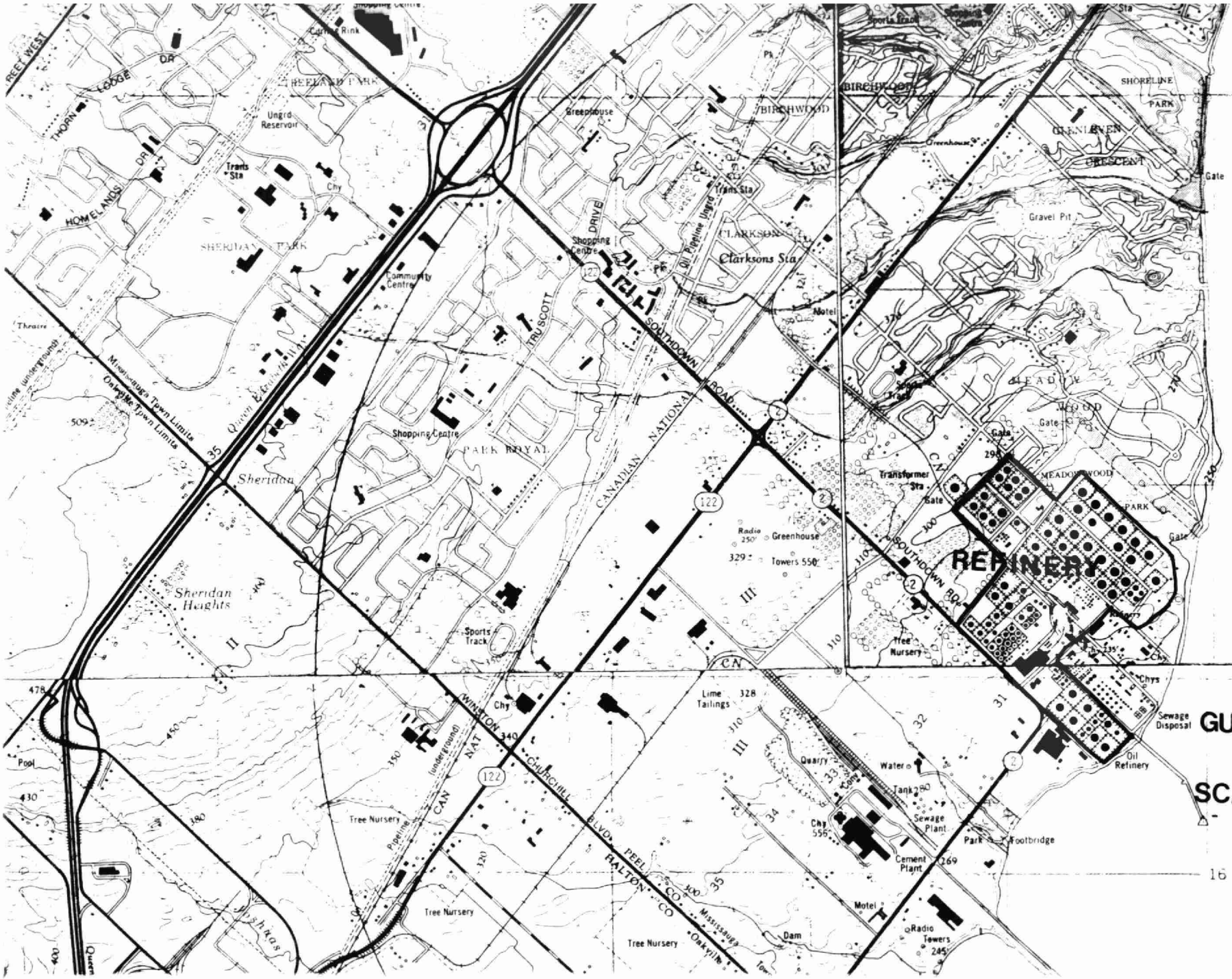
3. Factors Affecting Transport of Pollutants

a) Physical Factors

(i) Site Description: Gulf

The Gulf Clarkson Refinery is located in western Mississauga near Lake Ontario (as indicated on Map 1). The refinery property is bordered by:

Southwest - Southdown Road, an industrial area
Northwest - Orr Road, residential
Northeast - Meadow Wood Residential area
Southeast - Lake Ontario



MAP 1

GULF-MISSISSAUGA

SCALE 1:25000

Tank fields and pipeline occupy the northern part of the property. The main refinery operations, including the catalytic cracker, desulphurization unit and also the effluent treatment ponds occupy the southern portion of the property. Figures 1a and 1b illustrate the location of these operations.

The Gulf refinery grounds are quite flat with some landscaping such as the berms and vegetation found along the north and east edges of the property. The closest residential area to the refinery is less than one kilometer away. Land use between these areas includes roads and a small amount of open field with vegetation (See plates 1 and 2).

(ii) Site Description: Shell/BP

The Shell/BP refineries are located in Oakville close to the Burlington town limits (as indicated on Map 2). Shell's property covers 700 acres. BP's property occupies 300 acres. The refinery property is bordered by:

West - Burloak Drive and Burlington
North - Bronte Provincial Park
East - Residential area
South - Lake Ontario

Tank fields for Shell occupy the western part of the property; BP fields are to the east. Effluent treatment ponds are in the south end of both refineries.

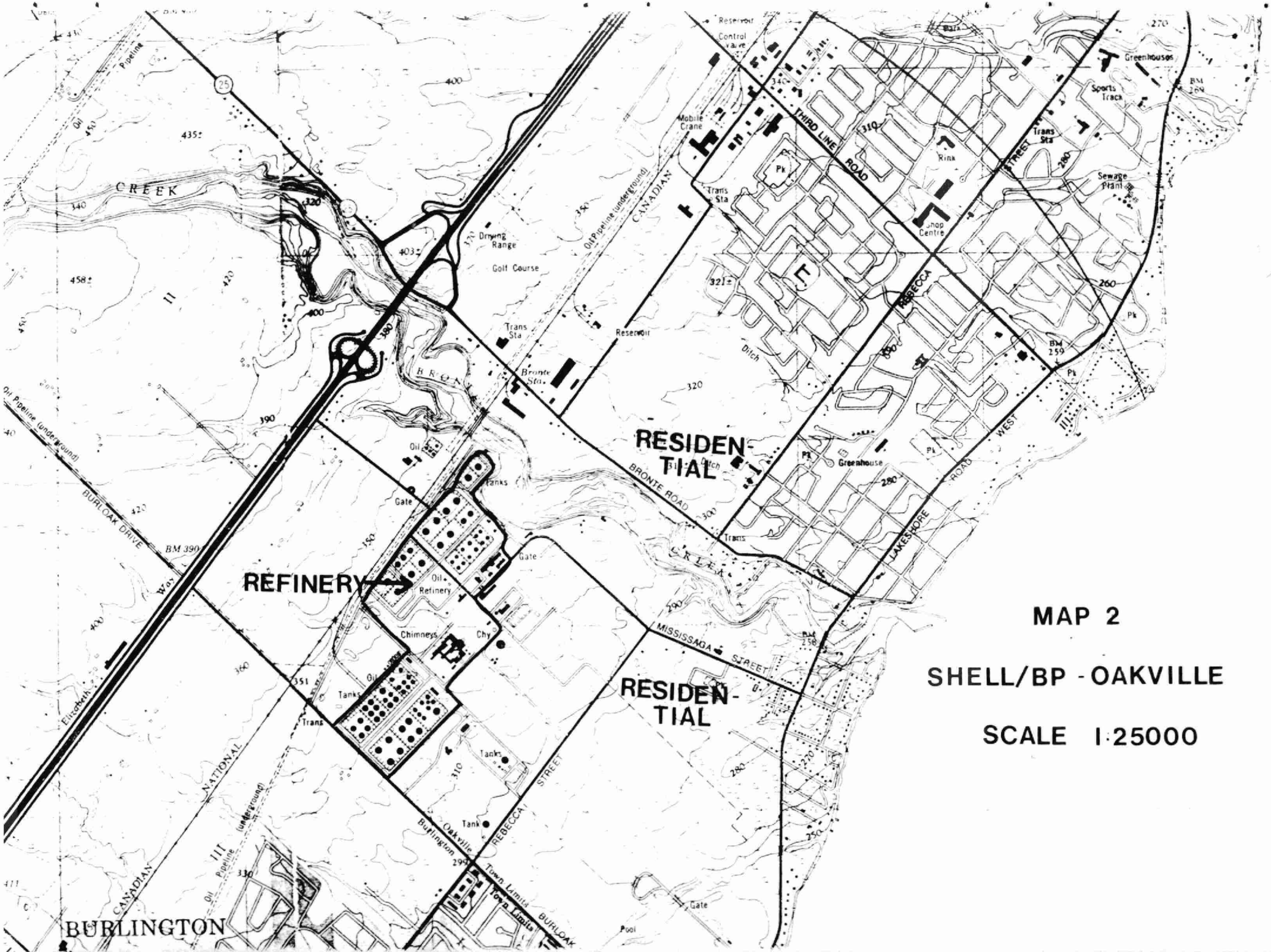
Vegetation cover surrounding both operations is moderate. A few berms are located to the north, as well as fairly mature tree lines.

PLATE 1

Meadow Wood Residential Area East of Gulf.
Note Density of Vegetation.

PLATE 2

Tree Line separating residential land use from
the Gulf refinery, on the property's North side.



MAP 2

SHELL/BP - OAKVILLE

SCALE 1:25000

The closest residential areas to the refineries are approximately one kilometer away. Land use between these two areas includes roads, open field (owned by the refineries) and treed lots (refinery property). These are illustrated in plates 3 and 4.

b) Climatological Conditions

(i) Wind Direction and Speed

In order to establish dominant wind patterns, information from the Ministry's Air Resources Branch was used. However, the location of the monitoring station is far removed from the refineries, making data for the most part quite general.

From 1974-79 prevailing winds were westerly (See Figure 2). Odours from the refineries tend to dissipate over eastern areas due to wind factors. This would account for the large number of complaints from such locations. However, since the west and south areas are dominated by open space and Lake Ontario, few if any complaints are received. Therefore, it cannot be stated with complete assurance that only locations east of the refineries receive these odours.

(ii) Temperature and Humidity

Due to the absence of monitoring stations in areas within proximity to the refineries, accurate data concerning temperature and humidity was unavailable.

High temperature and humidity can be related to an increase in odour intensity. On a large scale, warm moist air that is

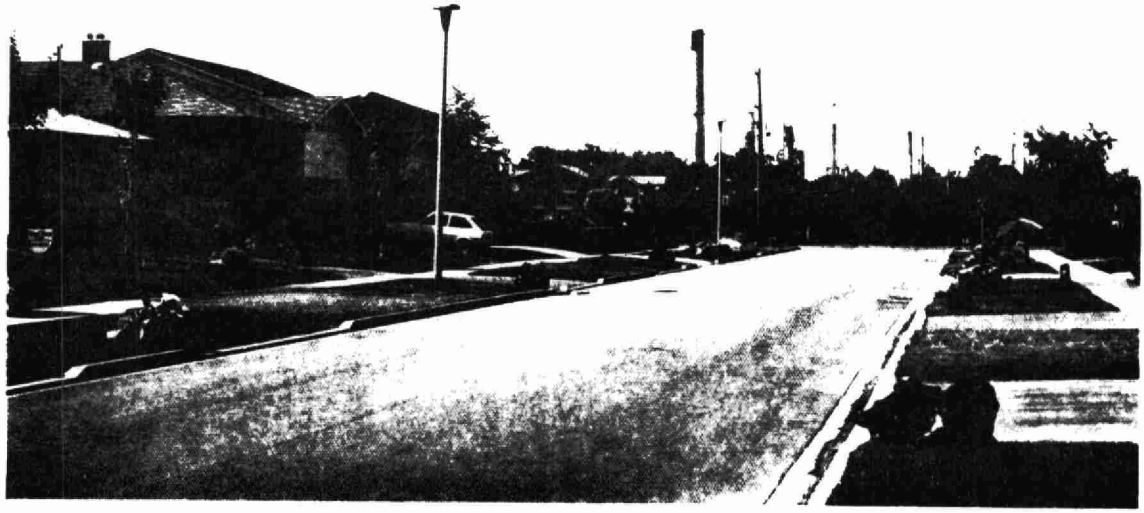


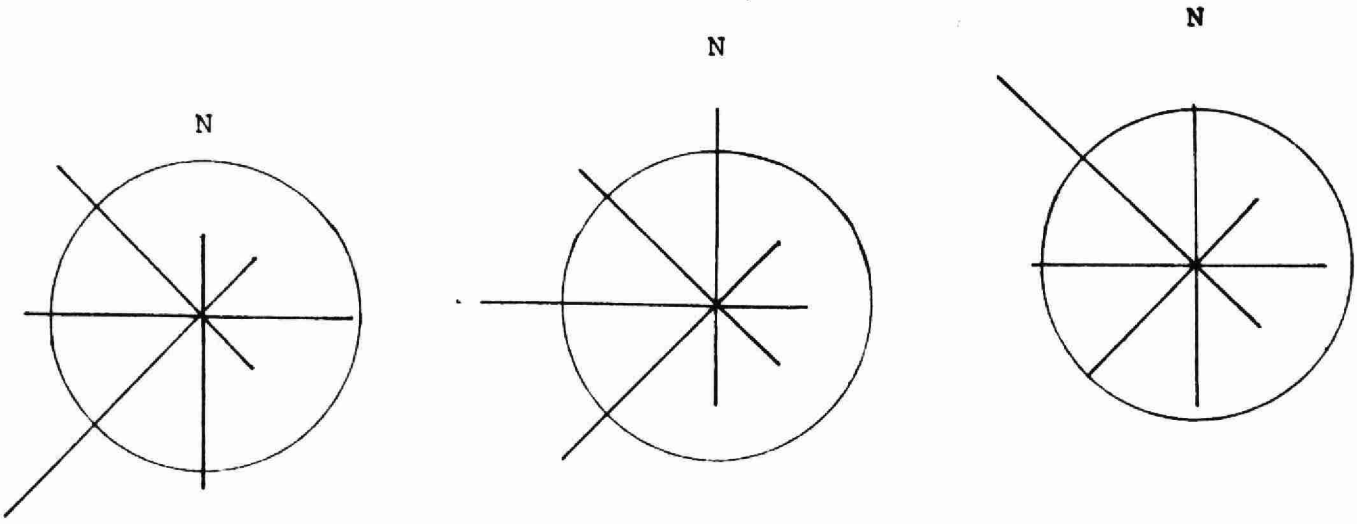
PLATE 3

Residential Area Surrounding Shell/BP
Refineries. Stack belongs to BP.

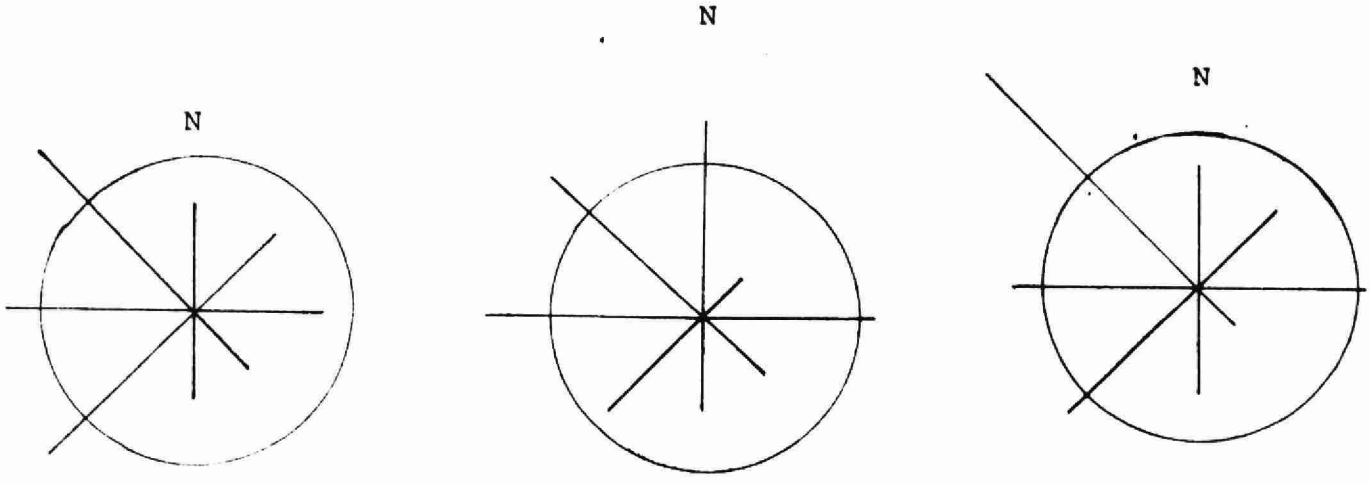
PLATE 4

Residential Area Surrounding Shell/BP.
Note Sparse Vegetation and Openness.

Figure 2: Seasonal wind direction frequencies in percentage of time. The circle represents 12.5%, or expected random frequency.



A. Sept. - Dec., 1974. C. Jan. - Dec., 1976. E. Jan. - Dec., 1978.



B. Jan. - Dec., 1975. D. Jan. - Dec., 1977. F. Jan. - May, 1979.

prevalent from the south-west (S.W.), will often bring a hazy, dirty air mass from the United States. On a more local level, high temperature and humidity will cause odours to collect near ground level.

It may then be possible that high temperatures and humidity will create odour problems affecting residential areas near the refineries. Odours collected near ground level and blown by S.W. winds could explain the dominance of complaints from residential areas to the east of the refineries, especially during summer months.

4. Receptors

a) Physical Factors

(i) Area Surrounding the Gulf Refinery

To the south of the Gulf property lies Lake Ontario. While occasional problems may occur, water pollution is not being considered in the present study. It may be noted that much of the area directly adjacent to the refinery property is occupied by the lake. Without significant population using the lake year-round it was not included in the analysis.

Land directly to the west and northwest of the refinery is primarily industrial. Nearby industries in this area also produce noise and odours; however, these can usually be distinguished from those arising from refining processes.

Further to the west, lies the residential area of Oakville, the nearest dwellings being about three kilometers from the refinery.

Immediately to the north of the grounds is a residential area, with homes very close to the property line (Plate 1), and similarly, to the east is the Meadowood residential area where many houses are within one kilometer of the refinery grounds (See plate 3). The topography of this area is flat but tree cover is quite extensive for a residential area.

(ii) Areas Surrounding Shell/BP

Developed residential areas are located to the east-south-east and the south-south-east of the Shell/BP refineries. These areas produce the largest number of complaints. However, the residential areas are more than one kilometer away from the refineries because of the extensive open space lands acquired by the refineries, as well as the separation afforded by the Twelve Mile Creek Valley. There are some apartment buildings visible from the refinery in a south-east direction just west of the Twelve Mile Creek. The area remains fairly open due to young vegetation cover (See plates 4 and 5).

To the south of the refineries are mainly undeveloped lands owned by the refineries, including the Shell Test Track and the Shell Park. Vegetation becomes fairly dense southwards towards Lake Ontario, where there are several private properites along the lakeshore.

Open space and parkland dominate the north/northwest region of the refineries. Difficulty in determining how these areas are affected by odour problems is due to a lack of complaint data from this basically uninhabited location.

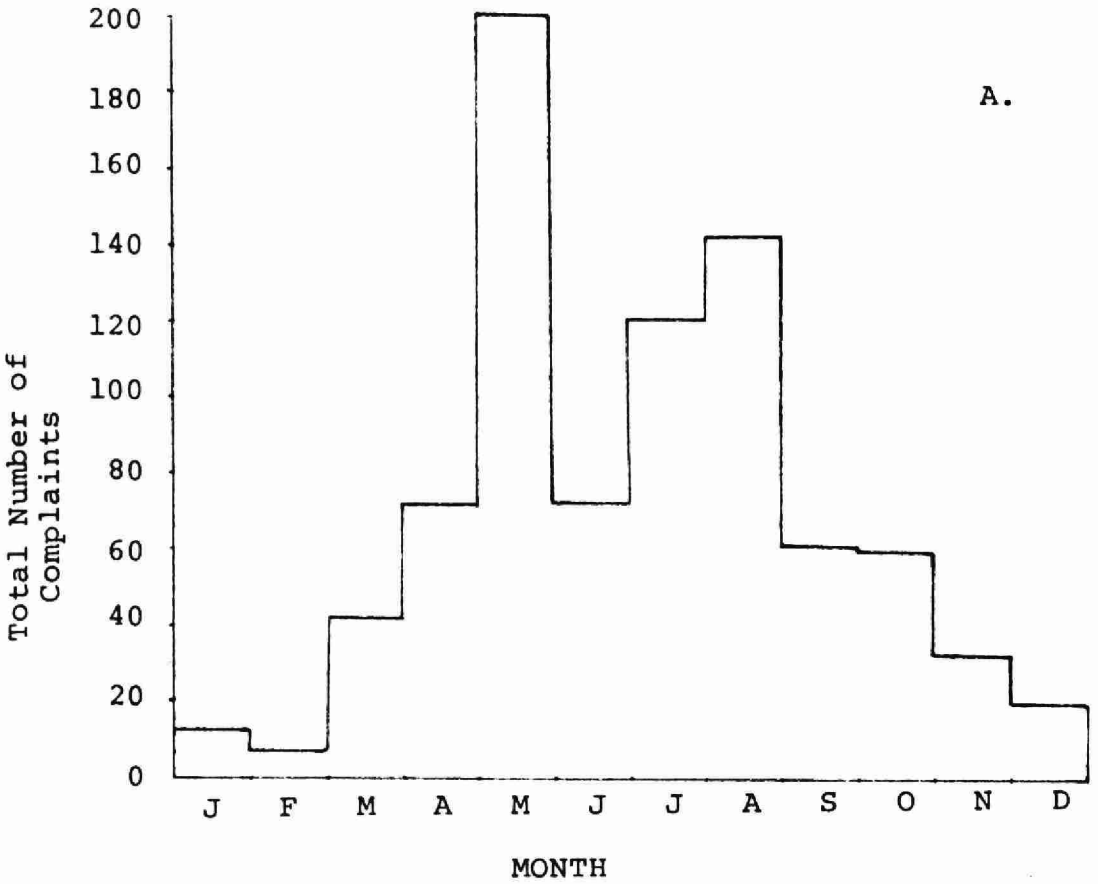
Although the built-up area of Burlington has not been developed close to the west side of Shell/BP, there are some scatterred residential areas west of the refineries with new subdivision development being proposed near the actual property line of Shell.

b) Temporal Factors

(i) Seasonal

In order to establish whether season had any relation to number of complaints received, data was broken into complaints per month and actual complaint days per month (number of days on which complaints were received). By establishing the second category, particular isolated incidents, or accidents causing large numbers of complaints (which bias data to a certain degree) could be taken into account. Figures 3A-3D display such data, and depict monthly or seasonal variations in complaints received.

A number of variables may explain such seasonal variation. Production varies according to seasonal demand; weather patterns differ with time of year; residents tend to spend more time outdoors in warmer weather thus noting the presence of odours.



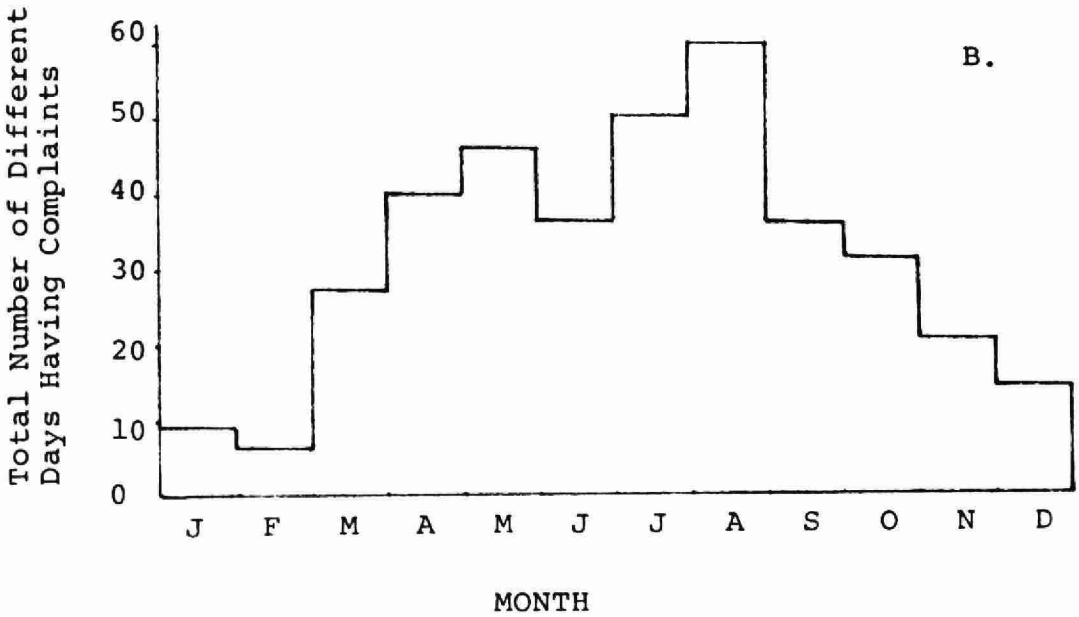


Figure 3 : Number of Complaints (A) and Number of Days upon which Complaints Occurred (B), by Month, over the Period Jan 1, 1974 to Dec. 31, 1978. Gulf Refinery.

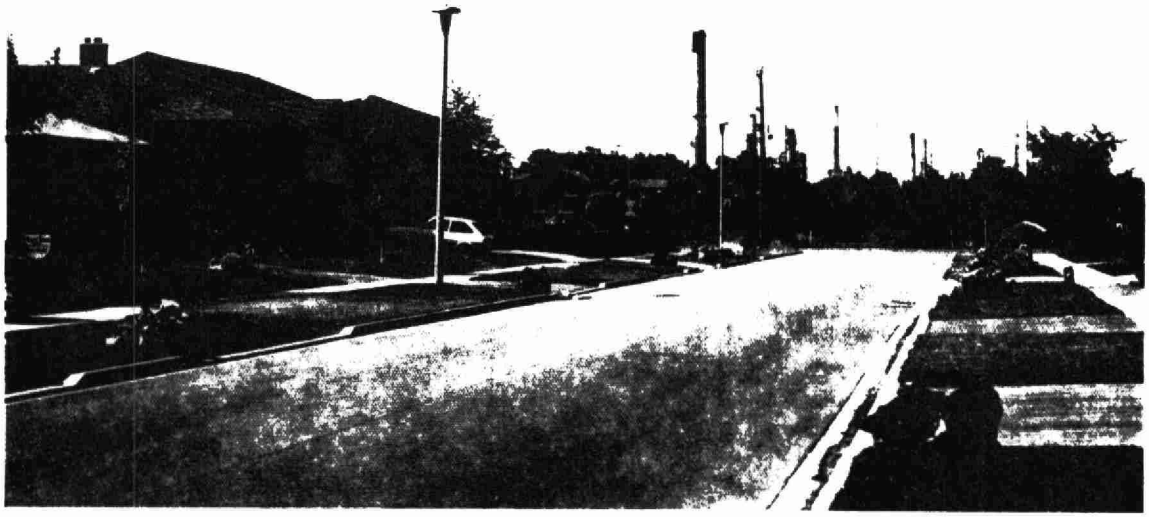


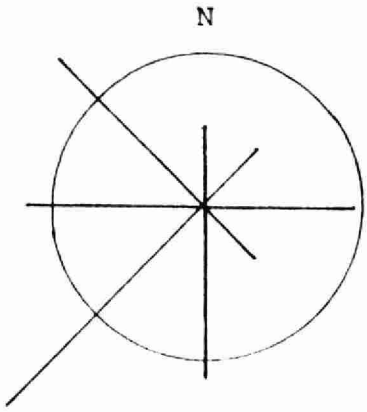
PLATE 3

Residential Area Surrounding Shell/BP
Refineries. Stack belongs to BP.

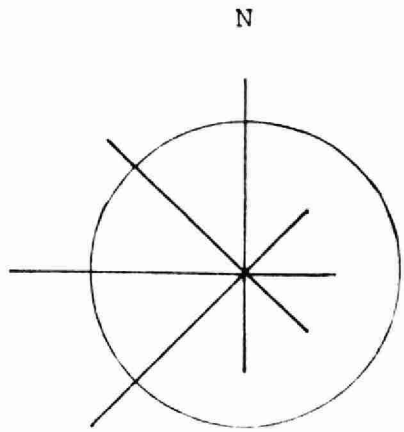
PLATE 4

Residential Area Surrounding Shell/BP.
Note Sparse Vegetation and Openness.

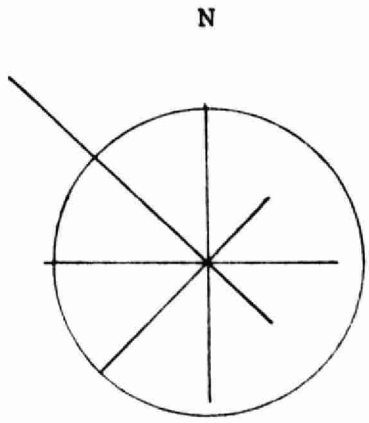
Figure 2: Seasonal wind direction frequencies in percentage of time. The circle represents 12.5%, or expected random frequency.



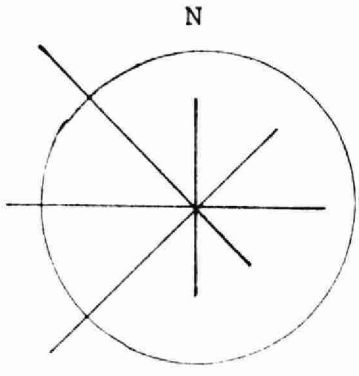
A. Sept. - Dec., 1974.



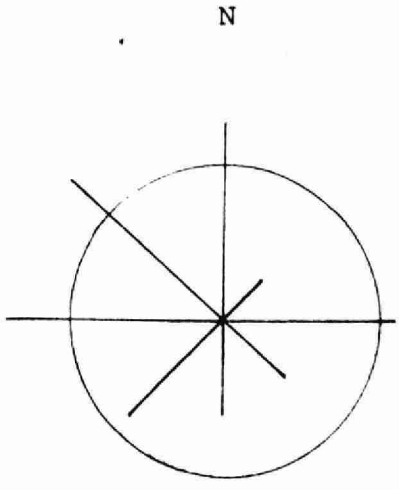
C. Jan. - Dec., 1976.



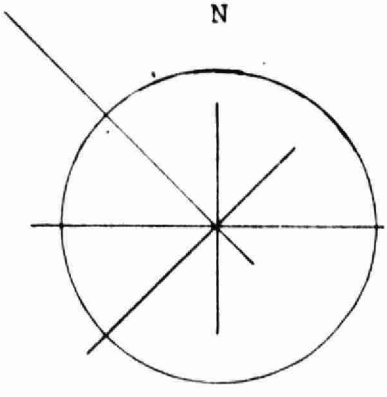
E. Jan. - Dec., 1978.



B. Jan. - Dec., 1975.



D. Jan. - Dec., 1977.



F. Jan. - May, 1979.

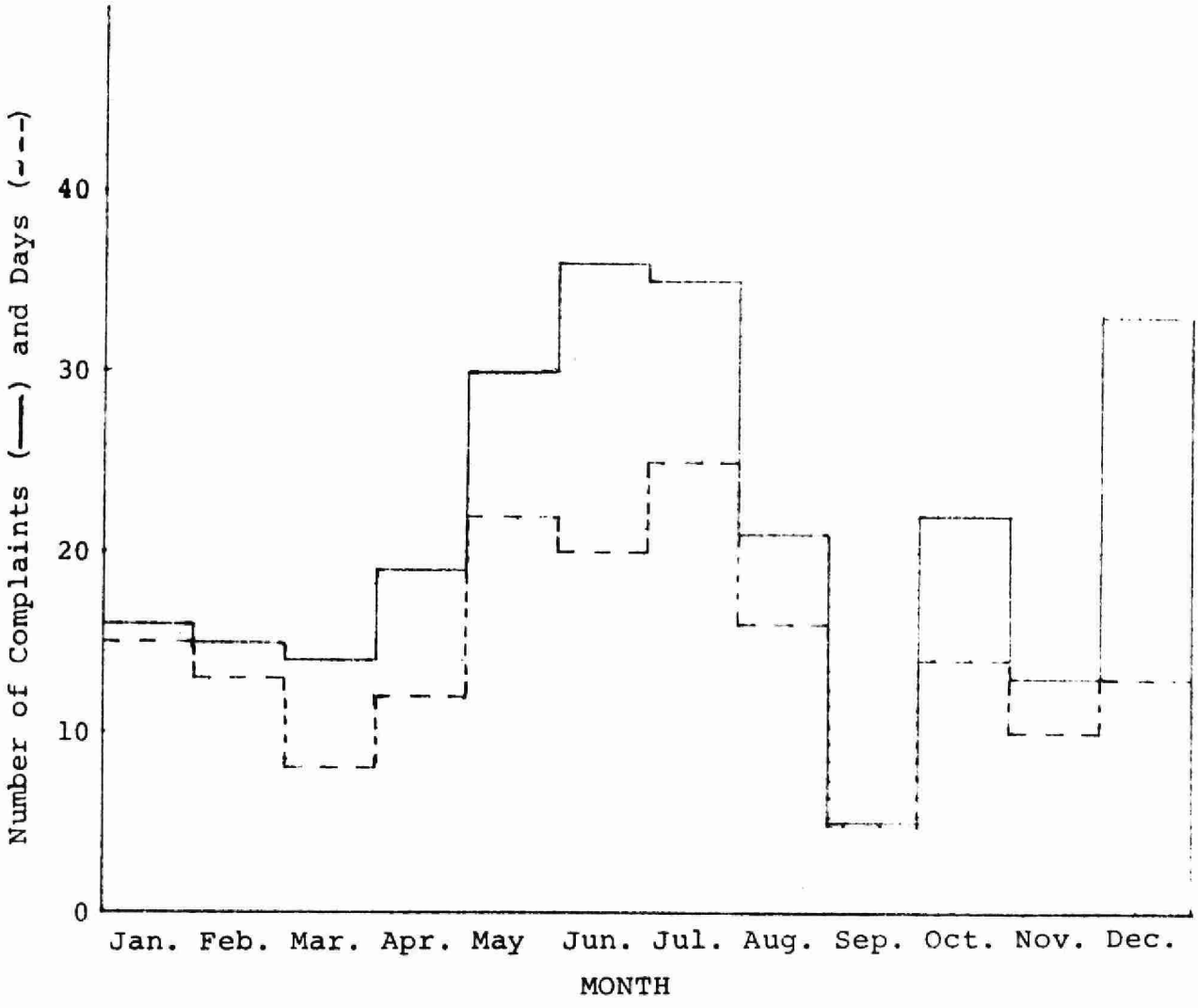


Figure 3 : Total Number, by Month, of Complaints (——) C, and D, Days (---) for which Complaints were Received, from Jan. 1, 1974 to Dec. 31, 1978. Shell/BP Refineries.

(ii) Time of Complaint

Each day was broken into four categories in order to establish whether the majority of complaints could be isolated to certain time periods. The results are shown in Table 1 below.

Time	Gulf # of Comp.	Gulf % of Comp.	Shell/BP # of Comp.	Shell/BP % of Comp.
12.01 a.m. - 6.00 a.m.	9	1	8	3
6.01 a.m. - noon	299	32	102	38
12.01 p.m. - 6.00 p.m.	439	47	91	34
6.01 p.m. - midnight	188	20	66	25

TABLE 1: No. of Complaints by Time of Day

As indicated, in the case of Shell/BP, 38% of all complaints occur between 6.01 a.m. and noon. Further, it was noted that most complaints were from women during this time period, whereas complaints from men increased later in the day. Such factors could be attributed to the larger number of women at home, or in gardens during the day and the high proportion of people actually awake and thus aware of odours during this period.

The distribution of complaints from the Gulf area is distributed over morning, afternoon and evening, most being received during mid-morning and early afternoon.

c) Perception and Awareness of the Problem

Tolerance and perception of odours varies among individuals. Various factors must be taken into account in order to gain an understanding of differences in perception or tolerance.

Awareness of the complaint procedure influences perception. If an individual has no knowledge of MOE's activities concerning odour problems, one may feel that the problem cannot be overcome and must be tolerated. Tolerance may then increase as perception decreases.

Conversely, if an individual is aware of MOE's complaint procedure, perception may increase. Less intense odours may be perceived as being more unpleasant than they actually are to most others; tolerance then decreases. In some cases such attitudes may produce a few individuals who complain repeatedly.

Previous experience with odour sources may also influence individual tolerance or perception. If a person had, in the past resided near other malodourous operations, they may be able to tolerate refinery emissions better than those who had no previous experience with such sources, or, on the other hand, their experience may have sensitized them, increasing their awareness of the problem. Problem perception will vary among these individuals.

Ratepayers groups that are active within the community have an effect upon perception and tolerance. Such groups may cause individuals to become more aware of odours and perhaps reduce their level of tolerance.

Some groups may demand action as indicated by meetings, petitions, or constant phoning in of complaints. These measures are two-fold in effect. First, they make MOE staff aware of

odour problems within the community which may, depending upon the degree of severity, enable a request for further control measures from the refineries. Secondly, perception of odours among residents is increased and tolerance is perhaps lowered. It may then become extremely difficult for sensitized individuals to reside comfortably in their location.

d) Socio/Economic Characteristics

(i) Gulf

As indicated on Map 3, the study area has been broken down into census tracts which were obtained from Statistics Canada. Table 2 below indicates some of the various socio/economic factors common to the tracts.

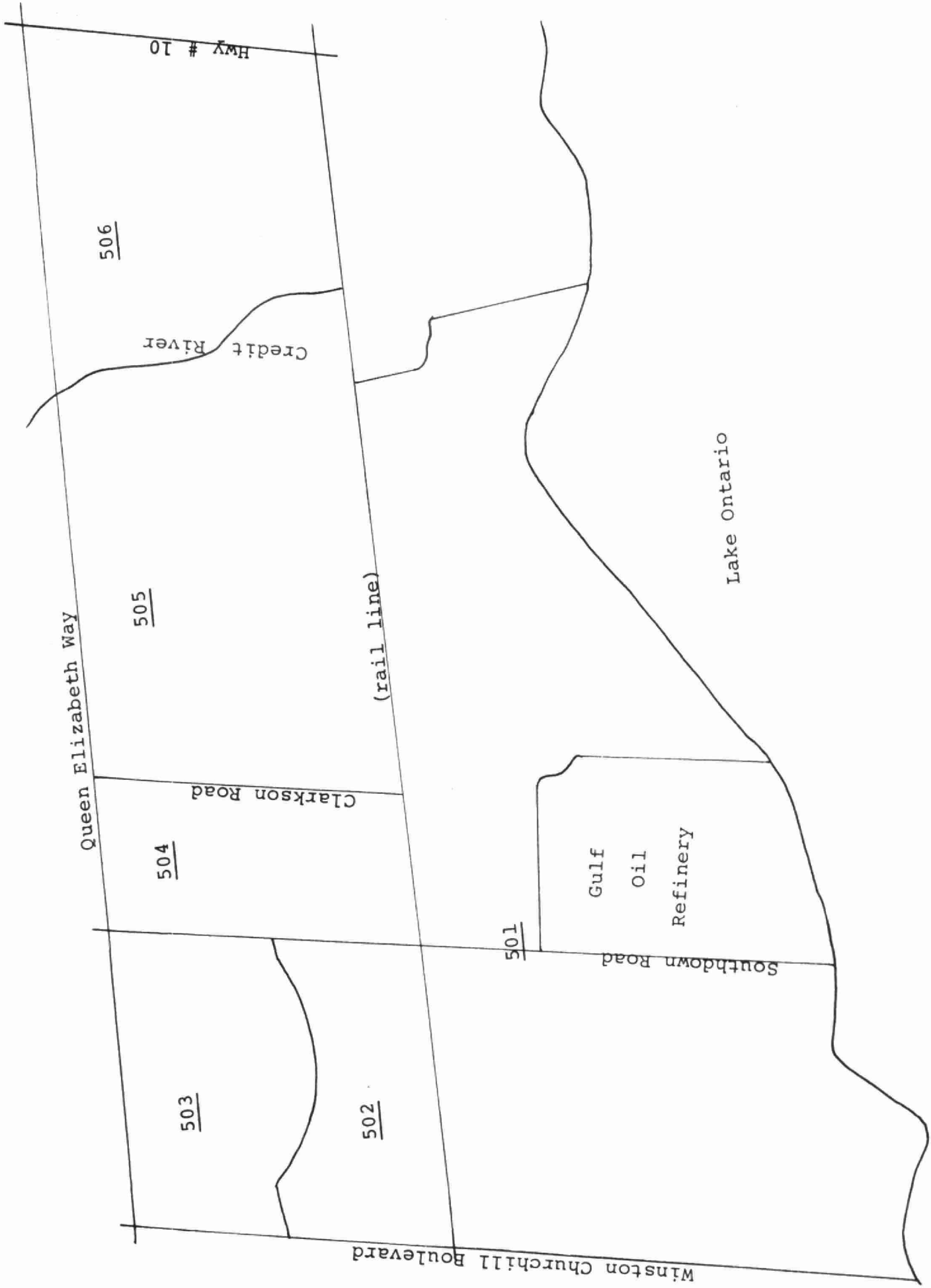
	Census Tracts 1976					
Tract No.	501	502	503	504	505	506
Pop. 1976	7,904	8,621	5,736	4,486	7,994	2,636
Density Per Sq.Kilom.	610.35	4,685.33	3,414.29	3,322.96	1,235.55	1,456.35
Occupied Hslds.						
Owned	1,845	1,790	925	925	2,015	730
Rented	345	480	675	235	85	60
Avg. Hsld. Income (1971)	20,979.			14,406.		

Average Household Income - Mississauga (1971) 13,532

TABLE 2

The most obvious feature displayed in Table 2 is that the area closest to the refinery, Meadow Wood, lies within a census tract having a substantially higher than average income. Since density figures apply to entire tracts regardless of whether

MAP 3 : Census Tracts



they are only partially developed, figures are not relevant here. A site visit of tract 501 revealed a quiet residential area of spacious, well-treed lots.

However, the vast majority of complaints around the Gulf refinery arise from a single, large census tract. Therefore, comparisons around the refinery cannot be accurately made.

(ii) Shell/BP

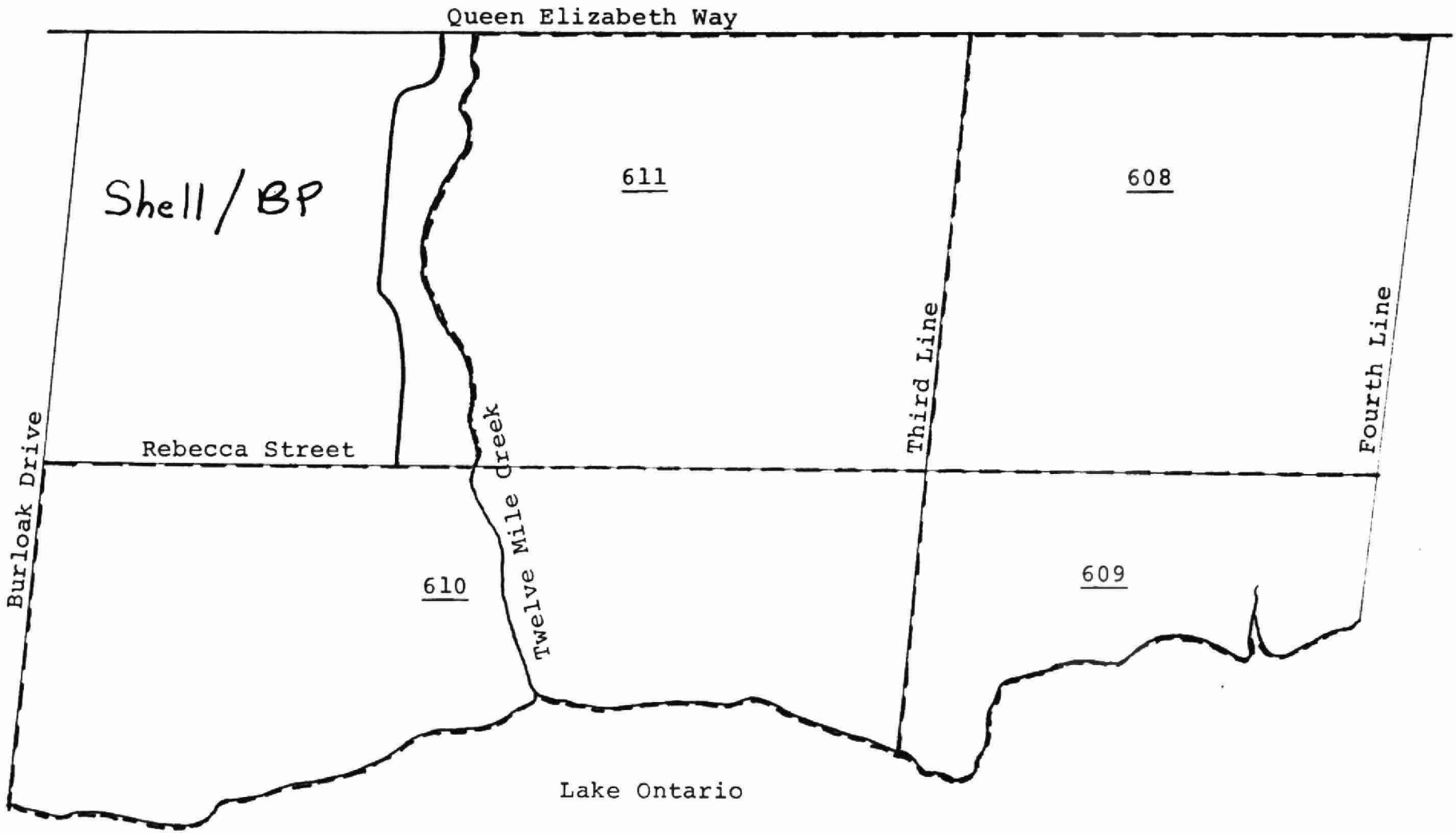
Using census information from Statistics Canada, the study area has been broken down into tracts (See Map 4). Table 3 below indicates some of the various socio/economic factors common to these tracts. To illustrate the sample size of the census, Tract 611 surveyed 103 addresses and Tract 610 surveyed 27 addresses.

Census Tracts 1976

Tract No.	608	609	610	611
Pop. 1976	3,217	3,328	7,760	6,354
Density Per Sq.Kilom.	2,348.18	1,547.91	1,461.39	1,363.52
Occupied Hslds.				
Owned	700	820	1,315	1,530
Rented	140	60	1,320	45
Avg. Hsld. Income (1971)	12,013.00	17,545.00	11,871.00	13,442.00

TABLE 3

MAP 4 : Census Tracts



It can be observed that Tract 611, having the largest number of complaints, also has the highest number of owned households (see Table 2B). Tract 611, located to the east of the refineries, also has a much lower population density than Tract 608 further to the east, which has virtually no complaints - this may indicate a rapid dissipation of odours with distance in the direction of prevailing winds.

(iii) Property Values

Another economic aspect that may be affected by odours, is property values. It has been noted that complaints, from individuals who have considered selling their homes have increased. This could reflect a fear of losing money due to odour emissions from refineries. By increasing complaints homeowners may hope to achieve reduction in odours, thus making their property a more valuable and attractive selling item.

5. Complaint Data

a) Types of Complaints

Odour was the main nuisance factor affecting adjacent residential areas, while smoke, noise and particulates had less impact. Noise generally carries less distance than odour, and is more effectively attenuated by intervening objects. Smoke tends to produce mostly aesthetic concerns, as it rarely causes damage to property or individuals. Particulate matter, when released can carry some distance, but such occurrances are rare.

b) Number of Complaints

Complaint data was broken into three categories: 1) number of complaints per month; 2) number of complaint days per month; and 3) number of complaints per complainant. These categories were used to illustrate the manner in which data can be analyzed and interpreted.

Table 4A and 4B provide total monthly tabulations of complaints from January '74 - May '79 in the case of Shell/BP and January '74 - December '78 for Gulf. Separate yearly or monthly breakdowns are illustrated in Table 5A and 5B for Gulf and Tables 5C and 5D for Shell/BP.

GULF

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Complaints	13	7	43	72	200	74	119	143	61	59	34	22
Days	9	6	27	40	46	36	50	60	35	31	20	14

TOTAL			
ODOUR	SMOKE	NOISE	OTHER
678	89	60	65

TABLE 4A

SHELL/BP

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Complaints	17	23	18	21	30	36	35	21	5	22	13	33
Days	16	17	12	14	22	20	25	16	5	14	10	13

TOTAL			
ODOUR	SMOKE	NOISE	OTHER
216	81	5	3

TABLE 4B

GULF REFINERY
COMPLAINTS - JAN '74 - MAY '79

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	ODOUR	NOISE	SMOKE	OTHER
1974	0	0	1	1	23	4	2	4	12	2	5	0	54	54	3	1	3
1975	1	1	12	1	4	12	43	59	5	8	1	3	150	105	12	14	33
1976	3	3	18	31	33	30	16	24	12	4	3	6	173	151	23	19	7
1977	7	2	7	22	127	23	11	11	9	5	2	3	229	197	13	12	14
1978	2	1	5	17	13	5	47	45	23	40	23	10	231	171	9	45	8
1979	1	16	37	18	33	--	--	--	--	--	--	--	105	90	4	11	--

* Numbers may exceed totals due to multiple complaints

TABLE 5A

GULF REFINERY
COMPLAINT DAYS - JAN '74 - MAY '79

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1974	0	0	1	1	6	4	2	4	8	2	3	0
1975	1	1	4	1	2	4	19	23	5	8	1	3
1976	2	2	12	22	17	12	9	17	9	4	3	2
1977	4	2	7	8	17	12	7	5	4	4	2	3
1978	2	1	3	5	4	4	13	11	10	12	11	6
1979	1	5	10	5	8	--	--	--	--	--	--	--

* Numbers may exceed totals due to multiple complaints

TABLE 5B

SHELL/BP REFINERIES
COMPLAINTS - JAN '74 - MAY '79

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	ODOUR	NOISE	SMOKE	OTHER
1974	5	6	2	4	6	7	6	0	0	3	8	9	56	34	3	20	2
1975	5	1	0	0	4	5	4	1	2	2	1	1	26	12	2	14	0
1976	0	2	9	12	9	1	7	5	1	1	1	4	52	37	0	17	0
1977	4	5	2	3	5	2	8	0	1	2	0	19	51	46	0	8	0
1978	2	1	0	2	6	21	10	15	1	14	3	0	74	55	0	20	0
1979	1	8	1	1	0	--	--	--	--	--	--	--	15	13	0	2	1

* Numbers may exceed totals due to multiple complaints

TABLE 5C

SHELL/BP REFINERIES
COMPLAINT DAYS - JAN '74 - MAY '79

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1974	5	6	2	4	5	6	4	0	0	3	6	8
1975	5	1	0	0	3	3	3	1	2	2	1	1
1976	0	2	3	5	5	1	5	5	1	1	1	2
1977	4	3	2	3	5	2	6	0	1	1	0	2
1978	1	1	0	2	4	8	7	10	1	7	2	0
1979	1	4	1	1	0	--	--	--	--	--	--	--

* Numbers may exceed totals due to multiple complaints

TABLE 5D

Tables 6A and B illustrate number of complaints per complainant for the period January '74 - May '79.

GULF

No. of Complaints	No. of Complainants
1 - 10	245
11 - 20	7
21 - 30	3
31 - 40	1
41 - 50	0
> 50	3

TABLE 6A

SHELL/BP

No. of Complaints	No. of Complainants
1	83
2	19
3	9
4	7
5	5
> 5	5

TABLE 6B

* Numbers may be less than complaint totals due to anomyous calls, or calls taken without recording addresses.

Tables 5A, B, C and D illustrate the increase of complaints for Gulf and Shell/BP. It is difficult to give a definite reason for this, however the following is a partial list providing some explanations for the increase:

- increased awareness among residents of MOE and complaint process;
- tolerance of odours has decreased, perception increased;
- emergence of strong rate-payers' groups;
- increase in refinery shutdowns or breakdowns;
- severity or frequency of emissions from refineries may have increased.

Furthermore, it can be noted that odour is the main source of complaints. As indicated in Tables 4A and B, it is a more frequent problem and affects a larger area.

The number of complaints per complainant illustrates few people have registered a large number of complaints; rather most complainants have registered only one complaint in over five years. This may create problems when trying to assess to what degree odour discomfort exists. However, it should be remembered that complainants notify other sources, for example, the refineries or their Members of Parliament. As these files are not readily accessible and due to time constraints such sources had to be overlooked. Since complaints are actually on the increase, it is reasonable to state the problem still exists to a large degree.

c) Source - Receptor Distance

Complaints related to distance were broken down into two categories. Initially each complainant's address was plotted on

the map and distance from the source measured. Secondly, each individual complaint was plotted and distance measured. Due to difficulties in locating precise sources, general areas providing for the most conservative estimate, were used. Maps 1 and 2 in the Appendix illustrate the location of the complaints in relation to the Gulf and Shell/BP refineries.

TOTAL (Percent)
COMPLAINTS, TYPES OF COMPLAINTS and COMPLAINANTS
by DISTANCE (Gulf Refinery)

CUMULATIVE	TOTAL	ODOUR	SMOKE	NOISE	OTHER	COMPLAINANTS
1 km	77	76	82	95	73	53
2 km	88	87	90	98	88	69
3 km	94	93	98	100	92	83
4 km	96	95	99	100	98	88
4 km or greater	100	100	100	100	100	100

TABLE 7A

COMPLAINTS* by Distance (Shell/BP)

DISTANCE	TOTAL	ODOUR
1 km	0	0
2 km	55	55
3 km	90	90
4 km	95	94
4 km or greater	100	100

* Figures by percentage

TABLE 7B

COMPLAINANTS* by Distance (Shell/BP)

DISTANCE	TOTAL	ODOUR
1 km	0	0
2 km	56	56
3 km	81	81
4 km	90	89
4 km or greater	100	100

* Figures by percentage

TABLE 7C

With reference to Shell/BP, it must be noted that most complaints from distances greater than three kilometers are primarily related to isolated incidents. Information displayed in Table 7C suggests approximately 80% of refinery related complaints are located within a 3 kilometer radius of the Shell/BP site.

In the case of Gulf's refinery, a large number of complaints were received from a subdivision within one kilometer of the site. This explains the difference in figures of both sites, and data display.

An observation that can be deduced from Table 7 is that the closer the residents are located to odour sources, the more the complainants and complaints increase. There is also an increased liklihood individuals will complain more than once.

A measure of wind velocity may have revealed a possible correlation with the distance such that odours, represented by complaints, may have been transported. However, reliable data for wind speed was unavailable as the monitoring station was not close enough to the refineries or residential areas. It was also not certain at what recording height the data would have been reliable or what the dispersion characteristics of these odours would have been.

6. Discussion

Difficulties were experienced in measurement and source determination while undertaking the study. Often odours were

either mixed with others, or not totally discernable. It was, therefore, almost impossible to pinpoint one specific location as the source.

The relatively young nature of odour studies provides no accurate manner by which emissions can be measured or assessed. Identification remains subjective. Individuals have different levels of odour interpretation. Perception of intensity varies from person to person. Residents affected by allergies, asthma or other respiratory symptoms may find mild odours extremely intense or unbearable.

The 12 week period for data collection and analysis was a constraint, likely causing sample sizes to remain small, as data was confined to MOE files. Had a greater length of time been available, complaint data actually gathered from residents, refinery files, elected officials, ratepayers' groups or other sources perhaps could have established a larger sample. However, the data available enabled the plotting of distance with complaint levels and comparison with other factors.

Some variables require more research to establish their value. Population characteristics are available from Statistics Canada, but these figures only reveal limited information. Surveys of residents may have brought to light "chronic complainers", individuals with irritating health problems, those who are afraid to complain or a number of other influential factors. The number of complaints occurring within certain population densities was also not considered, but could likely be

approximated by a housing count in the affected areas and affected residential areas, to both the refineries.

Climatological influence requires more research. In the case of wind speed or direction, temperature and other characteristics data was inaccurate due to the distant location of monitoring stations. By increasing the proximity of such stations to both the refineries, perhaps more reliable and relevant measures could be derived. These variables could then be used to establish possible correlations with distance, intensity or duration of odours and other variables.

The results obtained here are qualitatively similar to those of the Nanticoke Buffer Study. The quantitative differences can be accounted for only in a general way since the methods used in that study are not given in detail. For example, in the determination of source-receptor distances, it is not clear what point of origin is used as the emission source; the stacks, property lines, or some common point between all possible emission sources (e.g. between stacks, flares and sewage lagoons).

The present study covers the period 1974 to 1978 inclusive, whereas the Nanticoke Study includes data only up to the beginning of 1976. Since the number of complaints have increased in recent years, most of the data used here are different from those of the Nanticoke Study.

7. Summary

Some tentative conclusions can be drawn about several important variables analyzed with the complaint data. Emphasis will be given to those factors which can be controlled, or otherwise accounted for in part at least, by land use planning.

: Climate - Due to uneven distribution of people around the refineries, conclusions concerning the wind's influence on odours are limited. Intuitively, and from what is known about dispersal of other pollutants, wind direction may play an important role. Further in-depth studies are required to establish the degree of importance.

The role of other climatological conditions, such as temperature and humidity on odour characteristics, was not determined in this study. They are undoubtably important in some instances, such as during periods of inversion, where not only odour dispersion may be affected, but people's tolerance modified.

: Topography - Due to differences of refineries, it is necessary to consider each site individually. Topography is most likely to be important in cases of extreme features, such as high hills, valleys, or in other similar situations. It was not possible to single out topography as an individual variable at these sites.

: Socio/Economic - Possibly the most complex of all variables to correlate with the complaint data are the socio-economic characteristics of receptors affected. Very little of this information about "effects" came from complaint forms, (e.g. a certain activity interrupted) and information on varying human perceptions, attitudes and on their cause from tolerances to the contaminants was not possible to determine. These were areas beyond the scope of this study.

A detailed survey, perhaps in the form of a "blind" questionnaire of residents living in affected areas may be required to unravel many of the complexities of such factors (e.g. how many people affected by air pollution actually complain?; and do such factors as visual "sight-lines" from residential properties to smoke stacks affect numbers of complaints?).

: Distance - Distance appears to be the most important variable in determining degree of nuisance from malodours. Due to uneven population distribution, this conclusion cannot be detailed in a quantitative manner, but qualitatively it would appear to be valid. An obvious way to minimize the problem is by maintaining sufficient distance between the source and the receptor.

Odour control is unlikely to eliminate all emissions from refineries. Malodours will always be present, although their intensity may be reduced. The best way to ensure minimal

conflict between two incompatible land-uses is through prevention: physical separation. Taking factors such as topography, prevailing winds, types of odours and frequency into account with previous experience of complaint incidences, minimum acceptable separation distances can be established.

Zones separating residential areas from refineries could be generally used as open space, parkland, or light, clean and dry industry. Some forms of agriculture may not be suitable. Particular land uses or activities not adversely affected by periodic emissions could be specified as permitted uses in local Official Plans, and their economic viability determined by the competing interests involved (i.e. polluting industry in association with municipal planners, affected land owners, etc.).

It should be understood that separation distances or buffer zones do not represent a 'license' for industries to produce more odours. One remedial measure that could be used under some circumstances is the inclusion in leases or purchase agreements of warning notices stating the potential nuisance effects of odours from nearby sources. This should be a planning measure to be used with caution as a last effort to ameliorate already bad situations, such as in odour-affected areas that are already largely developed with existing residences, but are still fairly distant from the source.

B. Meat Packing and Rendering Operations

1. Introduction

The purpose of this section is to examine the impact rendering and meat packing odours have upon surrounding land uses, as analyzed from the complaint data, and what variables may be useful for preventing such occurrences beyond source control.

Considering the nature of the processes and the raw materials used, it is not surprising that the odours from rendering and meat packing operations are among the most unpleasant odours produced. Fortunately, these operations are generally small, compared to some other types of industry. Actual numbers of complaints observed are considerably less than those for refineries. Use of best available pollution abatement equipment and good housekeeping practices should reduce the severity of emissions.

Two rendering operations, Gordon Young and Darling & Co., both located in and near the Toronto central waterfront, eastern industrial area, were studied, as well as a meat packing operation in the west-end of Toronto, including the Toronto Abattoirs.

2. Sources of Emission

a) Process: Rendering

Rendering plants deal with scraps not suitable for human consumption and converts them into saleable by-products. Such an operation produces malodours which are seldom health hazards.

Various sources, including packing houses, restaurants, and dead animal pick-ups provide inedibles for rendering operations. Trucks from each site gather bins or remains of animals during morning or afternoon.

Cookers are the primary source of odours. Essentially they break down the structure of animal matter into another form. Lesser, but significant sources of malodours include: (Osag, p.41)

- Processing tanks
- Feather driers
- Tallow presses
- Blood spray driers
- Percolator pan (steam & odours released)
- Storage areas) Large source of odour if raw materials
- Dump pits) are not fresh. Ideally raw materials should
- Hoggers) not be over 24 hours old when processed.

Final products from the operation are tallow, cattle feed and grease. The end products are not a source of odour concern.

b) Process: Meat Packing

Meat packing operations deal with food for human consumption, and involve slaughtering of animals. Animal arrival and holding pens create odour problems. Additional malodours are caused when these pens are cleaned, and contaminated bedding disposed of.

Paunch lining, composed of intestines and their contents provide another source of odour. When such matter is left for over twenty-four hours, extremely strong putrefaction odours may result. Such odours cause large numbers of complaints.

The end result of this process is food for human consumption. Meat is generally frozen and shipped to various markets. Odour problems are negligible at this stage.

PLATE 5

Contaminated Bedding from
Meat Packing Operation

c) Pollution Control Equipment

In the case of meat packing operations, pollution control equipment is limited. Good housekeeping, such as the continual removal of wastes from the area, is necessary to keep odours minimized. Sealed containers enclosing paunch lining or other unusable parts should be used to reduce odours.

Rendering operations use wet scrubbers and chlorine injections. Darling & Co., have a large scrubber, whereas Gordon Young uses a smaller one along with a steam condenser. Good housekeeping and cleanliness is vital to odour reduction.

d) Transportation

(i) Rendering

Rendering operations depend primarily upon trucks for transport of inedibles to the site. Generally, trucks will go to various pick-up points during the day, collecting small drums of waste. Odour problems may occur if the materials are over 24-hours old and undergoing putrefaction. Unloading such material can produce malodours that may disperse over surrounding land uses.

(ii) Meat Packing

Meat packing operations primarily use trucks or trains to transport cattle to the site. Since cattle are slaughtered on the site, putrefaction odours are not a source of concern within trains or trucks. Odour problems are confined to contaminated bedding and its disposal from the two modes of transportation. Such odours may disperse over surrounding land uses.

e) Scheduling Process

(i) Gordon Young

Trucks gathering material from outside the immediate location generally arrive between 9:00 and 10:00 A.M. Local trucks bring inedibles to the site until approximately 2:30 P.M. If the process has stopped, materials will sit in bins until the next morning. However, if a large amount of inedibles need processing, two shifts may be undertaken.

(ii) Darling & Co.

Operating hours are primarily late afternoon and evening, due to availability of material. Trucks collect inedibles during the

day from various sources and return to the plant later in the afternoon. Hence, odour is restricted more to evening than day hours.

(iii) Packing House Area

Slaughtering usually takes place in the early morning and continues until noon. Paunch lining is picked up also around noon, thus decreasing the possibility of odours lingering.

f) Summary

Having described the various emission sources, and controls for meat packing and rendering operations, one can observe that odour can result from fugitive sources, such as contaminated bedding and putrified organic material for both operations, as well as polluton control equipment breakdown in the case of rendering plants. Both residential and other industrial, commercial and transportation uses can be affected. Other variables exist which may further add to the impact of these uses and will be discussed in the next section.

3. Factors Affecting Transmission of Pollutants

a) Physical Features

(i) Site Description: Darling & Co.

Darling & Co., is an inedible rendering operation located south of Lakeshore Boulevard. Situated in a primarily industrial area, the nearest residences are approximately 2 kilometers away. Surrounding land use includes:

North - Smith Transport yards
East - vacant land
South - ship channel (lake)
West - Texaco storage tanks

The actual site itself is set back from other uses. Tanks containing tallow and grease can be found to the south of the plant, parking to the north, and fairly mature vegetation located to the north, east and west.

(ii) Site Description: Gordon Young

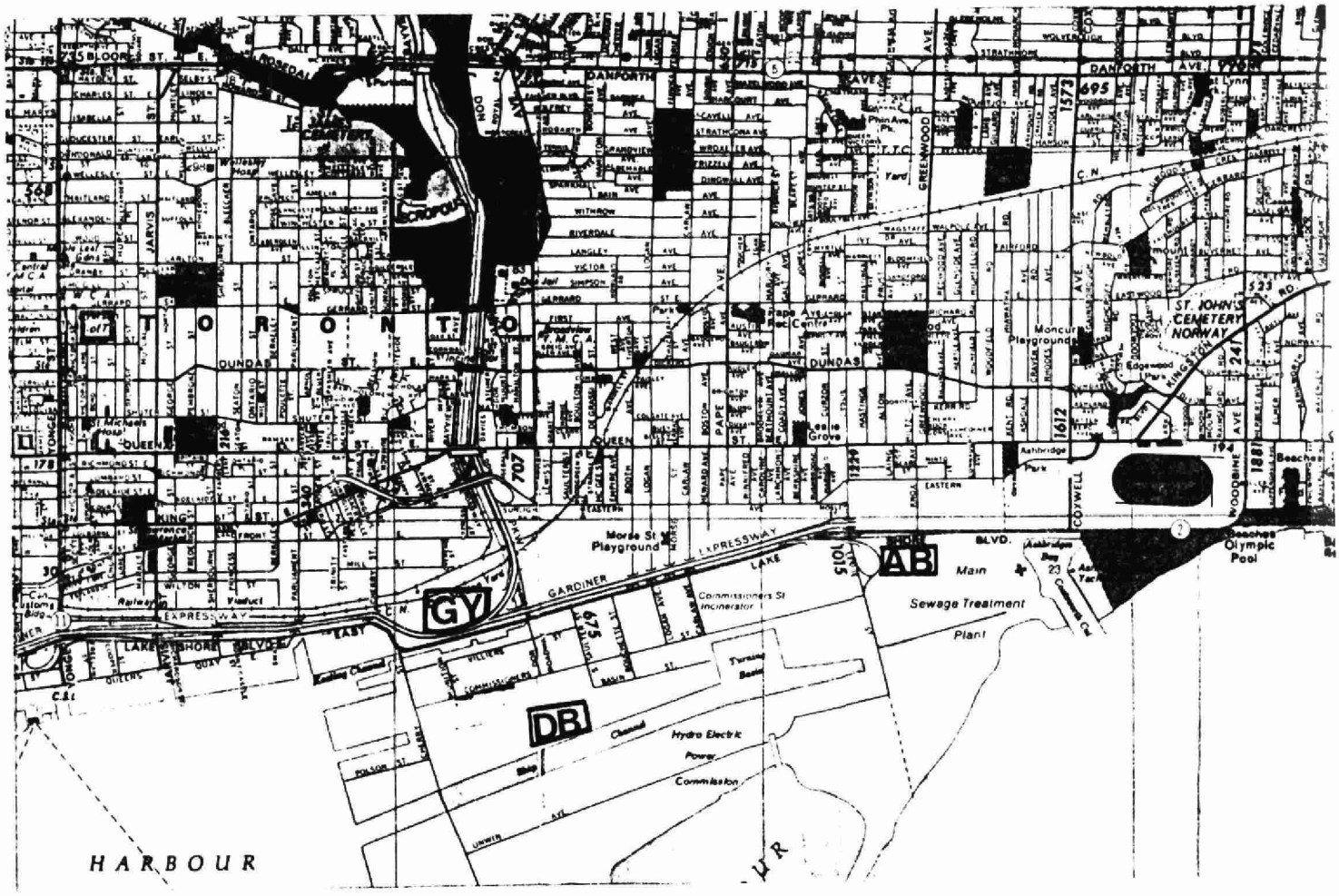
Gordon Young is an inedible rendering operation located at the junction of the Gardiner Expressway and Don Valley Parkway. The closest residences are approximately 1 kilometer away. Surrounding land uses include:

North - Gulf Oil
East - Gardiner Expressway
South - Lakeshore Boulevard
West - vacant land

The site is completely open, lacking any type of vegetation or natural buffer. The emission stack is located next to the Gardiner Expressway. General location of Gordon Young and Darling Bros. is indicated on Map 5.

(iii) Site Description: Toronto Abattoirs

Toronto Abattoirs perform both meat packing and rendering operations. The plant is located in the region of the western harbour, near King and Bathurst Streets. Residences are found within close proximity to the north of the operation.



MAP 5: Location of Gordon Young (GY), Darling Brothers (DB), and Ashbridges Bay Sewage Treatment Plant (AB).

Surrounding land uses include:

North - Metro Incinerator
East - Toronto Refiners
South - Gardiner Expressway
West - mixed use including railyards, Inglis, Massey Ferguson, Toronto Carpets

The site is located in an area where all available land is being used. Large numbers of buildings surround the operation. Vegetation is extremely limited.

(iv) Site Description: Packing House Area

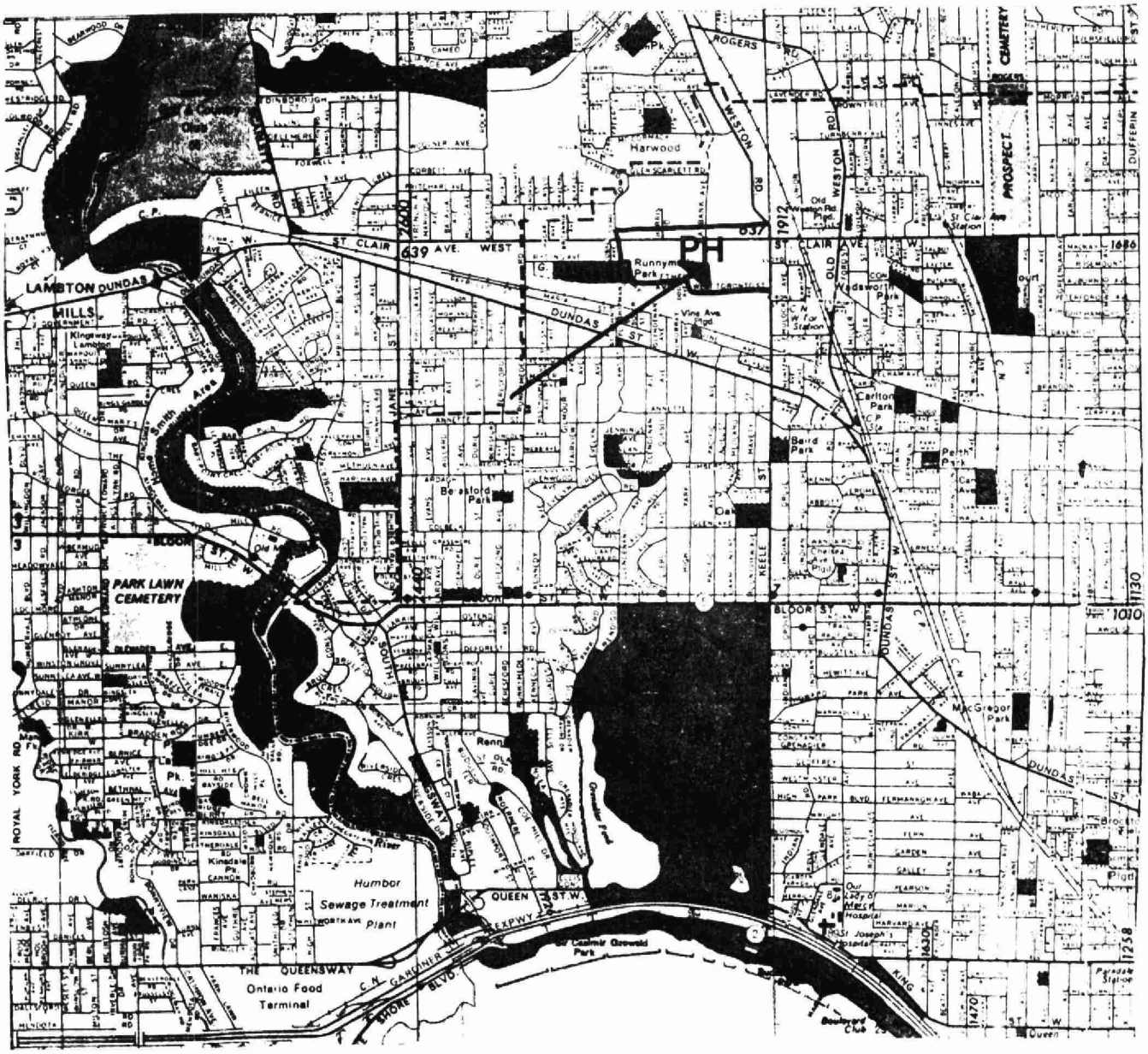
The Keele/St. Clair packing house area contains thirteen operations including one rendering plant. Residences are located nearby to the west. Surrounding uses include a variety of both industrial and commercial activities. The immediate area is well developed with little open space and virtually no vegetation. Map 6 indicates the general location of the packing house area.

b) Climatological Conditions

(i) Wind Direction and Speed

The effects of wind upon the dispersion of odours and other pollutants is very complex. Prevailing winds are those in the most frequently occurring direction, yet this may represent only a small percentage of the total time.

Wind direction and speed are greatly affected by topography and buildings. Due to the absence of a monitoring station near the



MAP 6: Location of Packing House Area (PH).

rendering or packing house operations, accurate wind data was unavailable. This created difficulty in establishing relationships between odour dispersal and wind.

A major upset on June 15, 1979, at Gordon Young, produced 22 complaints which were primarily from the Pape/Queen area (as indicated on Map 3 in the Appendix). Winds were from the south-west at 6 knots, which would account for the dominance of odour complaints to the north-east.

No predominant wind patterns were found when grouping data from the other operations. Such a phenomena could help to explain the lack of available complaint data.

(ii) Temperature and Humidity

Without more complaint data, it was not possible to correlate temperature and humidity to resulting odour problems. However, Figure 4 displays a predominance of odours during summer months. Due to high temperatures and humidity in summer months, putrefaction may occur at a faster rate. Thus, odours are more likely to prevail, and will be especially noted in residential areas where individuals will be outside more often.

4. Receptor

a) Physical Factors

(i) Darling & Co.

As previously noted, this operation is located in an industrial area, hence producing complaints from workers. Most operations

surrounding Darling & Co., are separated by fairly dense vegetation. Topography is essentially flat. Land use is intense with the exception of a vacant lot to the east.

Proximity to heavily travelled highways results in the exposure of many persons to odours produced. However, the presence of other odourous industries in the vicinity makes positive identification often impossible. Such exposures are of brief duration.

Residential areas are approximately 2 kilometers away. Topography is flat, with little vegetation and very few open spaces.

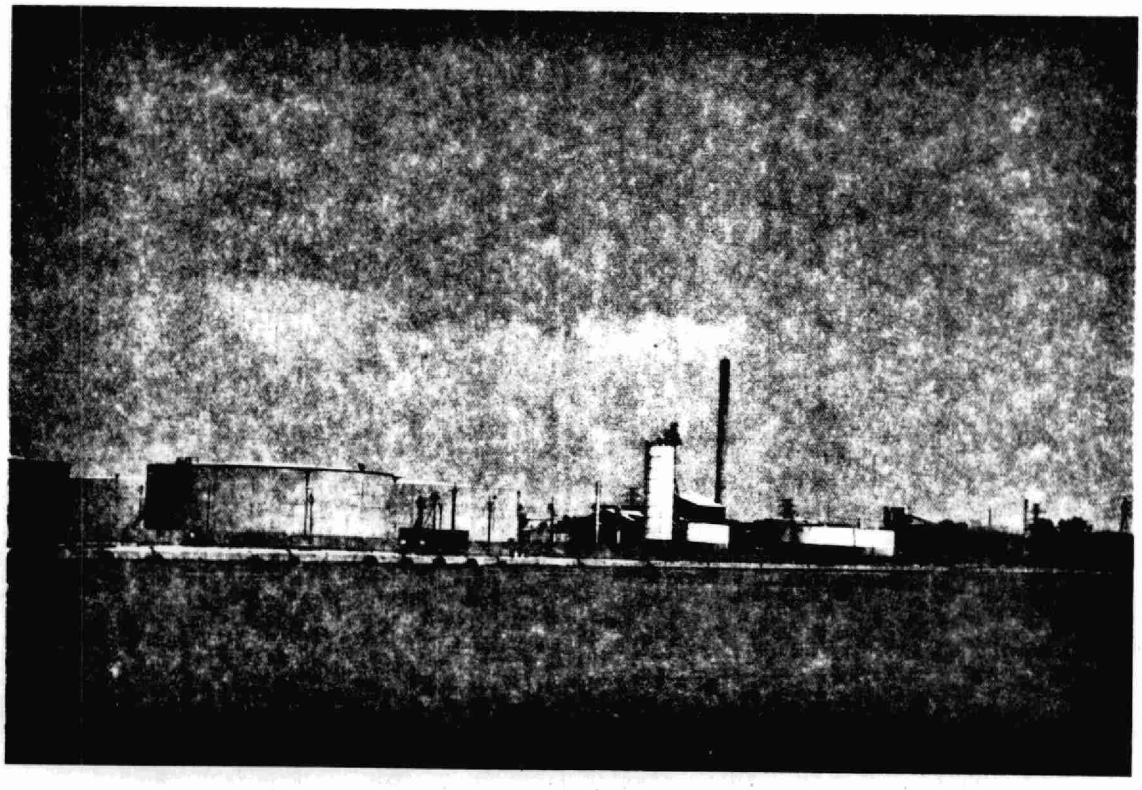


PLATE 6

Surrounding Land Use: Darling & Co.

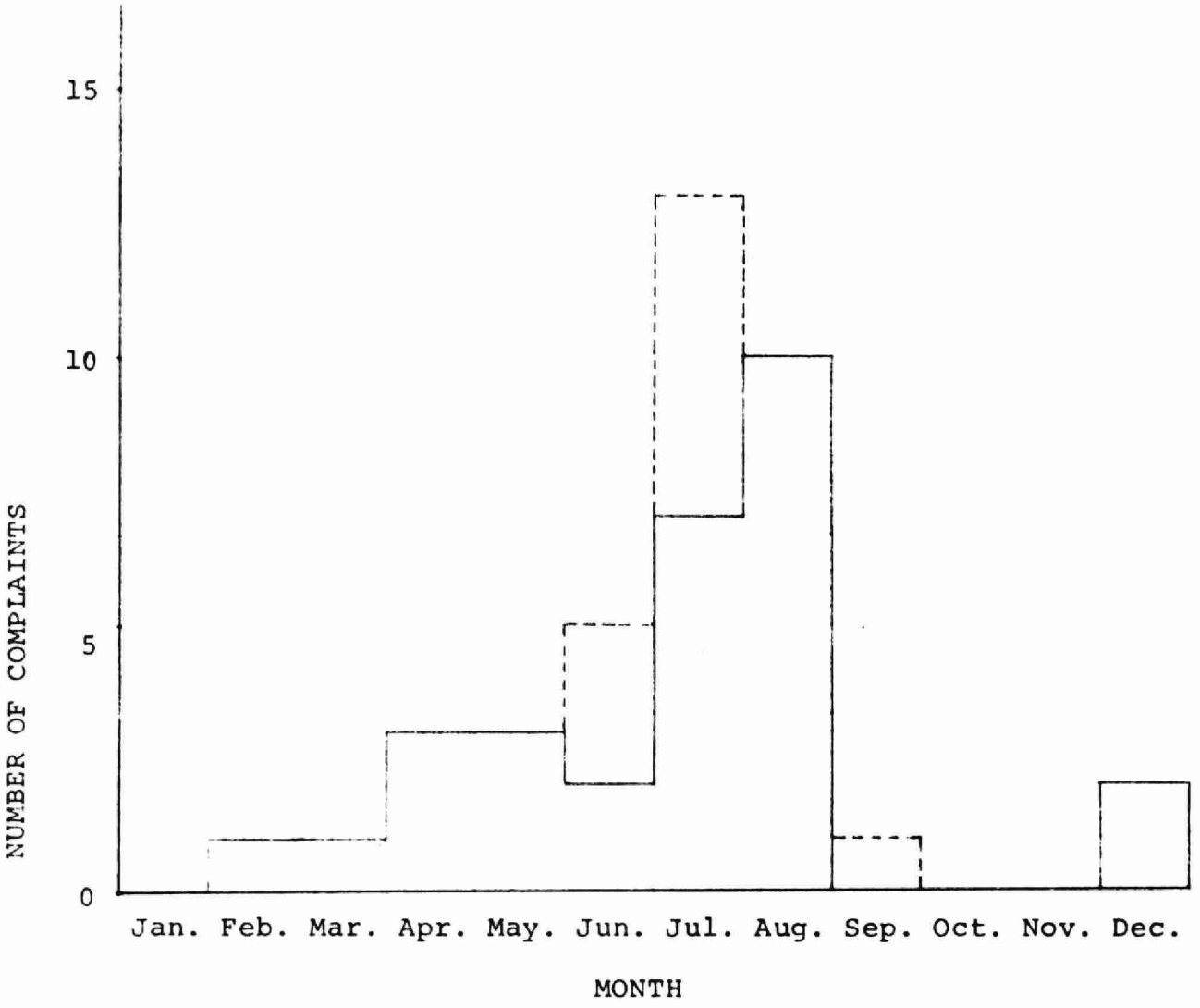


Figure 4 : Total Number of Complaints received, by Month, for, A, the Meat Packing Area plus Toronto Abattoirs (——), and, B, including Rendering Operations (---), over the period Jan, 1, 1974 to May 31, 1979.

(ii) Gordon Young

This operation is located in a relatively flat, open area. Commuters travelling along the Gardiner Expressway are most affected by odours due to the emission stack being located in proximity to the highway.

The closest residential areas are located approximately one kilometer away. Land use is intensive with the nearby highway, vegetation very sparse, and topography essentially flat.

(iii) Packing House Area

Land use in this location is extremely mixed. Heavily used areas incorporate industrial, residential and commercial activities. All available space is used. Residences are built upon small lots. High frequencies of truck traffic also affect the area.

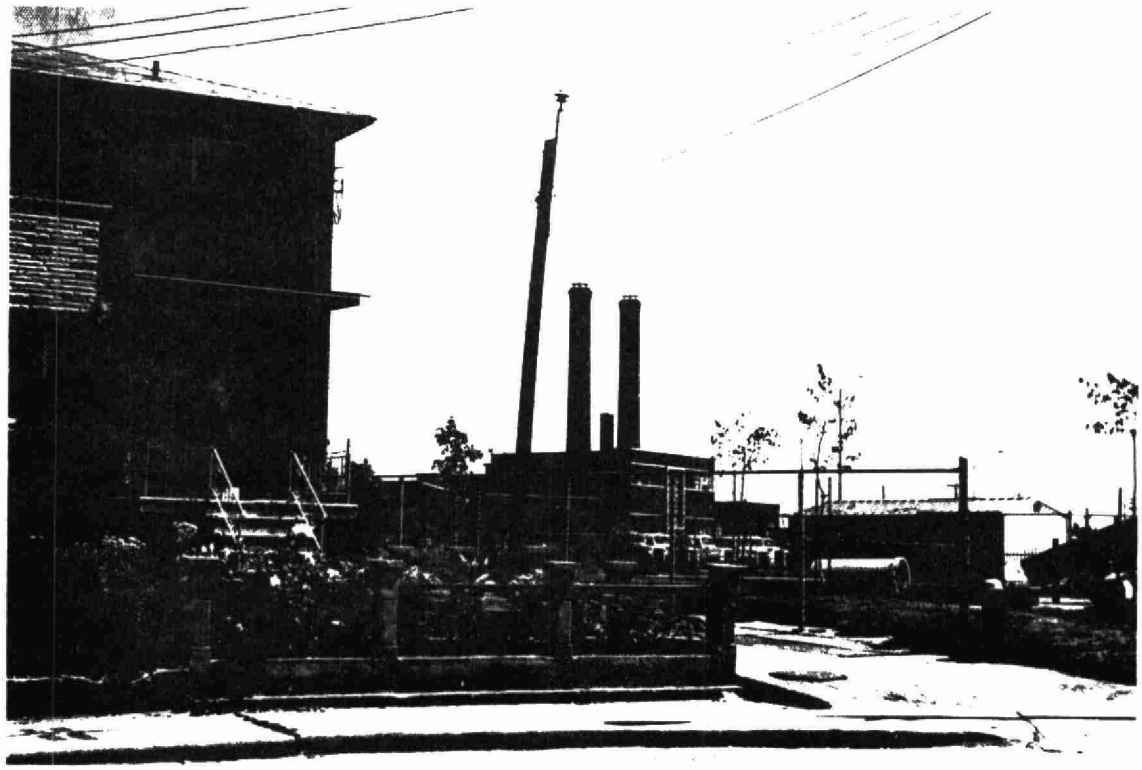


PLATE 7

Mixture of Land Use - Packing House Area

Topography is primarily flat, having a very limited vegetation cover, with the exception of the High Park area. Due to the large number of packing house operations, it is virtually impossible to pinpoint one odour source.

(iv) Toronto Abattoirs

Residences are located to the north of this operation within approximately 0.75 kilometer. Land use is mixed, industrial, commercial and residential. Topography is flat and vegetation cover is moderate.

b) Temporal Factors

(i) Seasonal

As previously noted for temperature and humidity, summer months produce more complaints than at other times. This is primarily due to increased temperatures speeding the process of putrefaction. More individuals outdoors during summer months with greater chance of exposure to odours, may account for increases in complaints.

(ii) Time of Complaint

Each day was broken into four categories in order to establish whether complaints were isolated to specific time periods. The results are shown in Table 8.

Time of Complaint - Jan, 1974 - June, 1979

Time	Gordon Young # of Comp.	Darling & Co. # of Comp.	Toronto Abattoirs # of Comp.	Packing House Area # of Comp.
12.01 a.m. - 6.00 a.m.	0	0	0	2
6.01 a.m. - noon	3	2	4	9
12.01 p.m. - 6.00 p.m.	5	1	5	3
6.01 p.m. - midnight	0	0	0	7

TABLE 8

Generally speaking, complaints occur from early morning to early evening, which are primary operating hours for the industries. However, in the case of the packing house area, the majority of complaints occurred between early morning and noon which is the time when most animals are slaughtered.

c) Perception and Awareness of the Problem

Tolerance and perception of odours vary among individuals. The highly ethnic background of residential areas close to rendering and meat packing operations may have an impact upon the levels of tolerance and perception of odours.

If individuals are unable to use MOE's complaint procedure due to an inability to speak Engligh or lack of understanding of the procedure, they may feel the problem must be tolerated. Therefore, even though complaints are few with odours present, complaints may not adequately represent the problem in these areas.

Previous experience with odours likely has an influence upon tolerance and perception. Many industrial European cities have significant, odour problems and people will be subjected frequently to malodours. Therefore, tolerance may be higher than with these individuals who have not been exposed to such odour problems.

It also did not appear from the complaint files that ratepayers' groups were active within the community. The absence of such groups limits numbers of complaints and does not accentuate awareness of complaint procedures. Therefore, tolerance may be higher and perception of the problem lower.

d) Socio/Economic Characteristics

With the aid of census information from Statistics Canada, residential areas surrounding meat packing or rendering operations were broken into census tracts. These tracts provide various socio/economic factors related to specific areas:

(i) Gordon Young/Darling & Co.

Darling & Co., is situated in a primarily industrial area, thus residential tracts were, for the most part, not applicable.

Gordon Young is surrounded by tracts 016, 018, 028, 030 and 033 (See Map 5 and Table 9). English is the dominant mother tongue, however migrants in the area come from outside Canada. Average income is low, housing is for the most part in single attached dwellings. These areas have produced 27% of all complaints recorded concerning meat packing and rendering operations.

(ii) Toronto Abattoir

This rendering and packing house is located in an area of mixed land use, although complaints have only been received from residences. Tracts 005, 007 and 010 surround the Abattoir (Map 6). It is a highly ethnic area with the dominant mother tongue being other than English or European (Table 9). A large proportion of migrants in this area are from outside Canada. The most common type of dwelling are apartments. These tracts have produced 22% of all complaints recorded concerning meat packing and rendering operations.

(iii) Packing House Area

Incorporated in this area are thirteen packing houses. Complaints are primarily received from tracts 051, 106, 153, 155 (High Park location). In comparison to the other areas these tracts have higher than average incomes, and a dominant English speaking population. Further, there are few migrants from outside Canada in the tracts. Apartments and single detached homes make up the prevalent residential pattern. These areas produce 51% of all complaints recorded concerning meat packing and rendering operations.

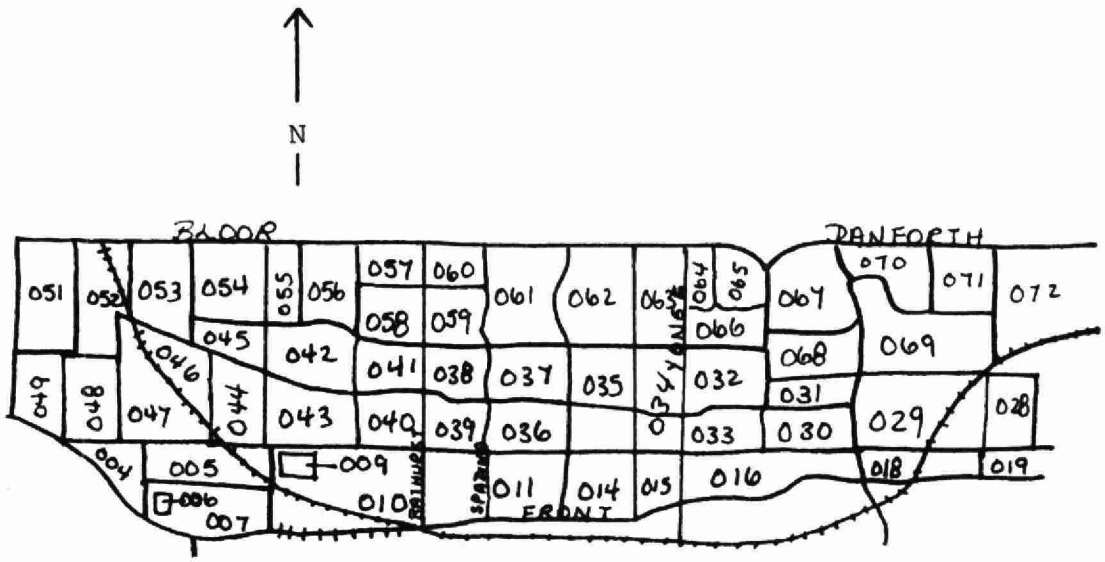
From the above three sections, it would appear that areas supporting higher income residents, and home owners produce the largest number of complaints. This could be due to an awareness of complaint procedures, the desire to protect an investment, or a dominant use of outdoor gardens and activities within the area. However, this is by no means conclusive. A more detailed study of socio/economic patterns of complainers is required.

CENSUS DATA

	TRACT NUMBER												
	005	007	010	016	018	028	029	030	033	051	106	153	155
Population (1976)	3412	8571	4423	1819	2551	6985	8002	4056	4138	7294	1975	4730	3369
Pop. Density Sq./Kilom.	9477.78	13766.13	6058.9	1823.88	5997.06	8694.03	9625.37	10400	13348	9582.09	1194.16	4683.17	4059.0
MOTHER TONGUE													
Eng.	2390	5790	1530	905	1630	3815	4515	3230	2875	3110	905	2940	2270
FR.	65	185	65	80	65	120	155	95	185	115	40	60	40
Gr.	65	175	45	10	10	60	30	5	50	270	30	85	35
It.	20	45	70	5	15	80	55	35	35	45	285	550	550
Uk.	70	115	200	15	5	25	20	10	65	505	20	105	20
Other	575	1745	2235	140	280	1505	1435	485	515	2070	290	805	360
Total Occ. Private Dwell.	1400	3685	1360	335	625	1550	1980	940	2005	2430	440	1400	1130
Single Det.	65	105	50	15	55	305	155	10	15	500	140	930	380
Single Att.	150	185	565	250	485	1065	690	420	170	140	260	345	190
Apartment	1175	3365	715	60	80	150	1110	515	1820	1465	35	105	525
Duplex	15	25	30	-	5	25	30	-	5	325	5	20	25
Mobility Status													
Pop. 5 yrs. & over	3175	7875	4090	1210	1780	5355	6040	3710	4015	6155	1615	4375	3090
Migrants	755	2705	1215	210	210	820	1020	465	875	1350	130	625	490
From Outside Canada	455	1805	1035	60	90	460	565	285	285	645	95	200	190
Avg. Total Income (hsld)	8363	8398	9276	6682	7596	8269	7045	6125	5681	13043	11072	10164	7583

TABLE 9

MAP 7: Census Data- Metropolitan Toronto



Not To Scale

Reasons for individuals living in proximity to meat packing or rendering operations and not complaining may vary. Due to the large ethnic population, it may be assumed that some individuals cannot speak English. This may inhibit an awareness of complaint procedures, or make them unable to easily complain. Some individuals feel that they had no real right to complain, since they bought a home in an area where they were aware of odours. Residents may feel also that it is useless to complain about large companies as little if any action would be taken.

Regardless of the reasons why individuals do or do not complain, the data available indicate that there are odour problems. Such problems have occurred because incompatible land uses were not controlled at an early stage in the planning of the area.

(iv) Property Values

Property values may be affected by odours. House values may be reduced where odours drift into residential areas. Effects can be psychological as well as economic. Seeing rendering or packing operations from one's backyard increases the perception of a problem and thus a person may feel justified in paying less for such accommodation. Further, complaints may not be received from such a location due to previous awareness of these malodours. In some cases however, people may not initially realize the extent of such odours and will later complain.

5. Complaint Data

a) Types of Complaints

Odour was examined in the study areas. This was the main factor affecting residences. Sources of malodours were extremely hard to pinpoint, due to the large variety of activities within surrounding locations.

b) Number of Complaints

Complaints concerning these operations are less than one would expect. Very few incidents occurred where large numbers of complaints were generated. For the most part, individuals complained only once, and reasons for such behaviour are unavailable. It may be presumed residents accept their plight, and feel little, or nothing can be done about odour emissions.

c) Source - Receptor Distance

Table 10A, below, illustrates complaints and distances for each type of operation.

TOTAL COMPLAINTS BY DISTANCE (RENDERING OPERATIONS)	
DISTANCE (km)	NUMBER (not cumulative)
.25 or less	6
.50	2
.75	1
1.0	1
1.5	7
2.0	9
2.5 or greater	2

TABLE 10A

TOTAL COMPLAINTS BY DISTANCE (PACKING HOUSE AREA, INCLUDING TORONTO ABATTOIR)	
DISTANCE (km)	NUMBER (not cumulative)
.25 or less	0
.50	6
.75	1
1.0	8
1.5	1
2.0 or greater	2

TABLE 10B

Due to difficulties in locating exact sources, general areas of emission that provided for conservative estimates of source-receptor distances were approximated. Limited data made the interpretation of the tables more difficult.

6. Discussion

Difficulties were experienced in measurement, source determination and the analysis of complaints. Often odours were not discernable due to close proximity of other sources. Therefore, precise information on the cause-effect relationship between specific rendering or meat packing operations and the affected residential areas was limited.

Some variables require more research to establish their value. Ethnic breakdowns were provided by Statistics Canada, however a resident survey may reveal other factors explaining why so few complaints were received.

Climatological influence requires more research. Due to the distant location of monitoring stations, data on wind direction, speed, temperature and other characteristics are for the most part difficult to correlate with the occurrence of complaints. Perhaps by increasing the proximity of these monitoring stations to the influenced area, more accurate measurements could be obtained and possible correlations established.

7. Summary

Some tentative conclusions can be drawn from data analysis:

: Climate - Due to uneven population distribution and other factors, the wind's influence on generating complaints is not easily established. Although wind patterns may play an important role, the absence of local monitoring stations in the affected areas limits conclusions regarding their influence.

: Temperature - High temperatures have impact upon the operations due to the exposure of products. Putrefaction becomes more rapid with rising temperatures. With higher temperatures occurring in the summer months, more residents and motorists are in the open air and exposed to odourous conditions. Such a factor would have to be considered when assessing land use compatibility.

: Transporation & Scheduling - Odours are prevalent during hours when trucks unload either animals or inedibles to respective operations. When operating during daytime hours, complaints are more frequent, as individuals become sensitized to odours.

: Socio/Economic - Refer to Section A7.

: Distance - Distance is the most important variable in determining degree of nuisance from malodours. By maintaining a sufficient distance between source and receptor, problems of malodours may be minimized.

Due to the few complaints received caused from rendering and meat packing operations, the extent to which they constitute a problem may be questioned. Further studies, for example, personal contact within the actual community, may provide clearer and better insights toward who is affected and to what degree by malodours.

C. Ashbridges Bay Sewage Treatment Plant

1. Introduction

The purpose of this section is to examine odour complaint data related to sewage treatment. Ashbridges Bay has produced many complaints although the majority are from past years.

As in the case of other emission sources examined, odours are of a nuisance nature, rather than a health hazard. Variables involved in land use compatibility concerning sewage treatment shall be examined.

2. Sources of Emission

Raw sewage, especially under anaerobic conditions, has a distinct odour. Degradation of organic material present in

sewage, results in the production of several malodours. These include hydrogen sulphide, and organic sulphur and nitrogen compounds such as mercaptans, skatole, indole and ammonia, some of which have very low threshold values.

The raw sewage entering the plant will have clearly developed odours. Any stages in the treatment process where the material is moved too slowly or allowed to accumulate can be expected to be a source of odour. If the plant is not overloaded, material passes through smoothly and quickly, and if good housekeeping practices are employed, odours can be kept at a minimum. Abatement techniques such as incineration, ozonation and chemical wet scrubbing, can remove most odours produced. Containment of odours which are not removed can help minimize the impact of odours upon the community.

The presence of industrial wastes in the sewage may present special problems when they occur, but are dealt with as they arise.

a) Pollution Control Equipment/Techniques

Various measures have been employed to reduce odours and pollution from going into the environment. Such features include:

- a 600 foot incinerator stack;
- covering aeration tanks to reduce musty odour;
- ozonation and wet scrubbers are used upon collected air which is then discharged from the stack;
- treated exhaust gases from sludge are discharged through the stack. Excess sludge is taken to landfill sites.

b) Process Scheduling

The plant operates on a twenty-four hour basis. Overloading may cause back-ups which will increase odours. It is difficult to confine odour sources to one particular time period.

c) Summary

Having examined various factors causing odour emission from Ashbridges Bay, it is necessary to examine their impact upon surrounding land uses. It should be kept in mind that complaints have been reduced over the past years, and this can be largely attributed to improved pollution control measures at the source.

3. Factors Affecting Transport of Pollutants

a) Physical Factors

(i) Site Description

The sewage treatment plant is located west of Ashbridges Bay Park and close to the Leslie Street Spit. The plant covers approximately 40 hectares.

Ashbridges Bay is one of the largest treatment plants in the country, with a capacity of 180 million gallons per day (MGD). Recent additions such as the incinerator and stack make it one of the most up-to-date facilities as well.

The area itself is open, with a mixture of flat and rolling topography. Vegetation is sparse, and open space is dominant.

b) Climatological Conditions

(i) Wind Direction and Speed

As indicated by climatological data from Toronto Island, prevailing winds in this area are not constant. Hence, wind direction may influence the spread of odours at any particular time and no generalizations may be made.

(ii) Temperature and Humidity

High temperatures will effect the rate of bacterial decomposition. When water temperatures are high in shallow ponds, sludge mats may rise from the bottom, and usually become covered in blue-green algae. Odours occur due to the decaying matter.

Furthermore, high temperature and humidity cause other odours, especially those associated with sludge incineration, to increase. In the case of Ashbridges Bay, high humidity is usually associated with light winds. As a result, odours disperse close to ground level, and their intensity increases, affecting various land uses.

4. Receptors

a) Physical Factors

Map 5, page 55, indicates the general location of the Ashbridges Bay plant on the Toronto Waterfront beside Ashbridges Bay. The sewage treatment plant has adjacent land uses as follows:

North:	Lakeshore Blvd., industrial strip approximately .25 km.;
Northeast and Northwest:	Low density residential areas;
South:	Lake Ontario, Outer Harbour East Headland;
East:	Ashbridges and Woodbine Parks, Beaches Parks including Kew Beach and Balmy Beach;
West:	Industrial Area.

The topography of the affected areas is primarily flat, however some complaint locations are distant with intervening valleys. Vegetation varies from open, sparse areas to well-treed areas.

Residential areas are well established with many turn of the century homes. The sewage treatment plant has a lower elevation in comparison to surrounding residential areas. These low-lying areas have a built-in potential for odour problems due to meteorological effects associated with valleys. Plates 9 and 10 indicate the proximity of the surrounding area and the size of the incinerator stack.

b) Temporal Factors

(i) Seasonal

Data were placed into two categories, number of complaints received, and complaint days per month. The second category was established in order to place less stress upon isolated incidents, accidents which often produce large numbers of complaints.

As indicated in Figure 5, most complaints are confined to summer months. A variety of reasons could explain this phenomena. As mentioned in Section 3b(i), high temperatures have influence upon odours. Since such temperatures are confined mostly to summer months, it is reasonable to assume odours will be prevalent during this season. Further, more people are out-of-doors during summer months and thus more exposed to odours.

Plate 8 Ashbridges Bay Sewage Treatment Plant and Surrounding Area

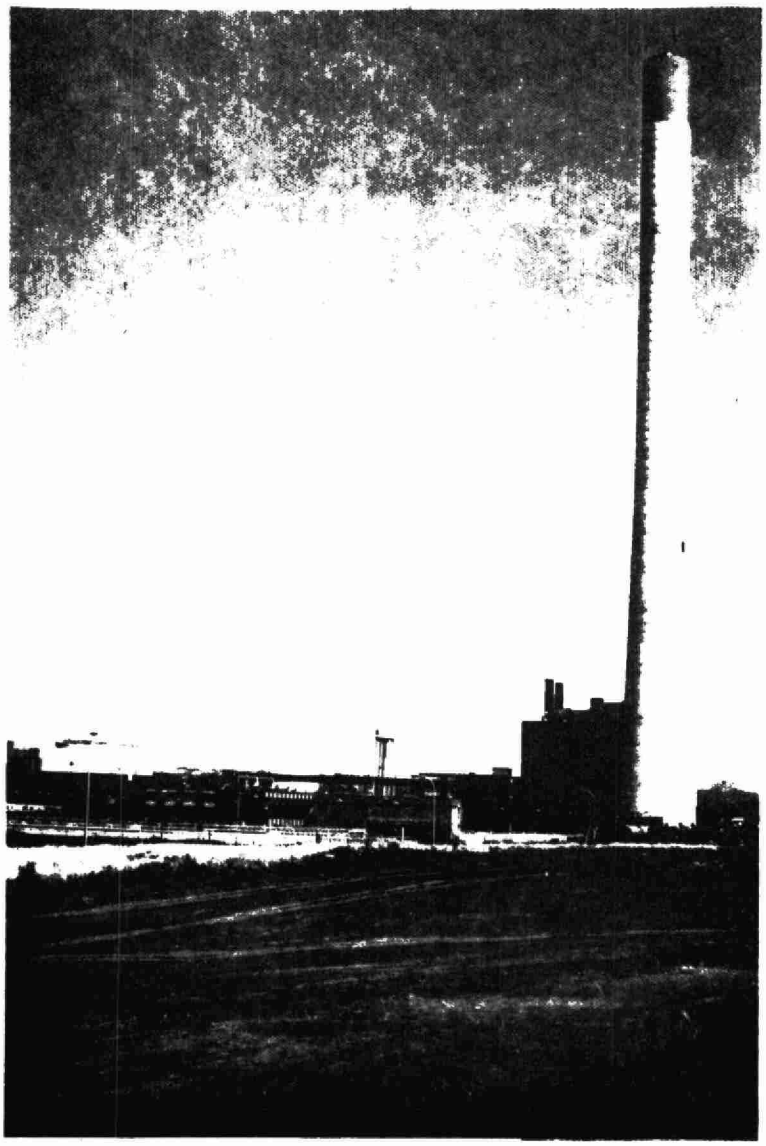


Plate 9

Ashbridges Bay Sewage Treatment Plant showing Incinerator Stack

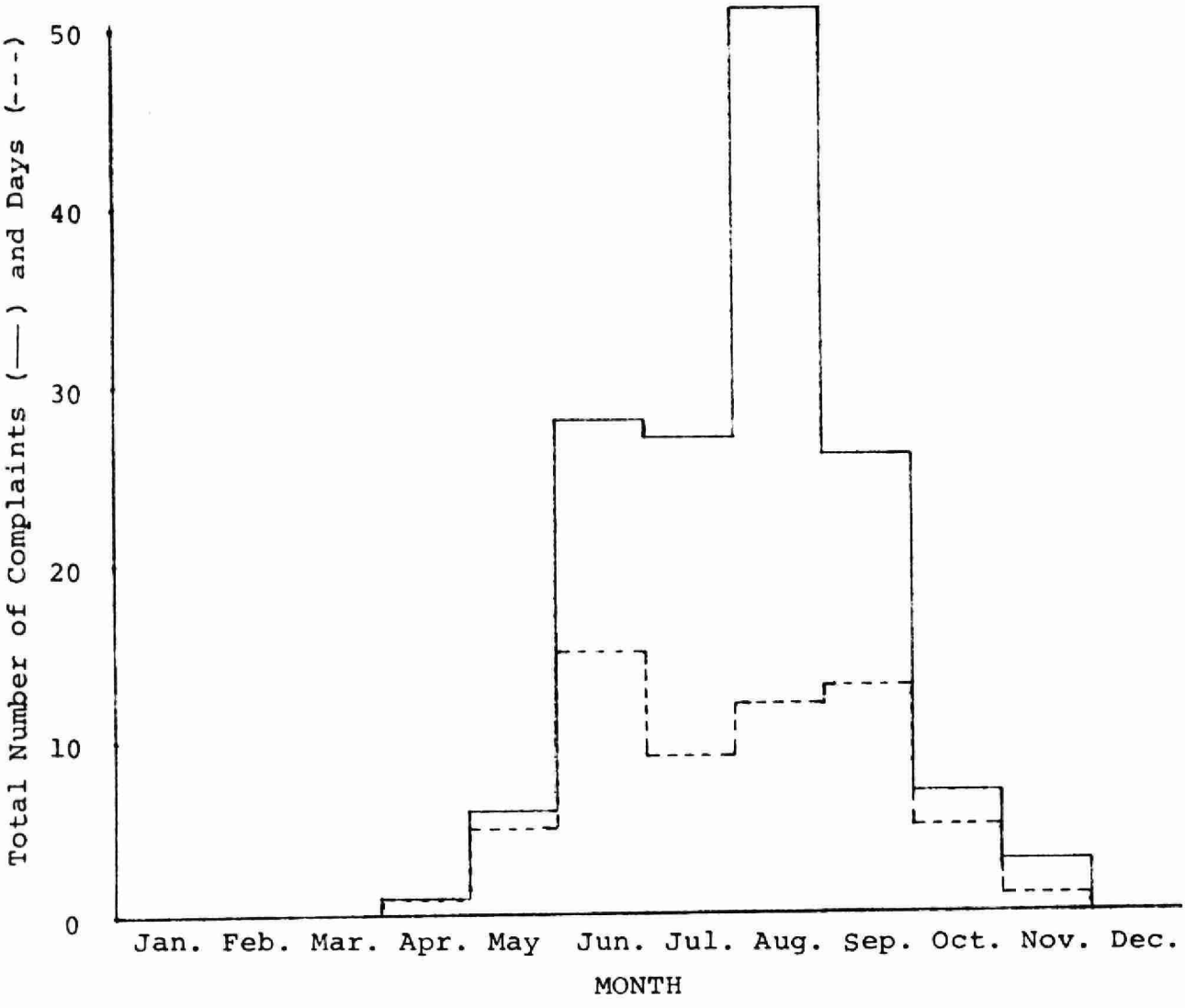


Figure 5: Total Number, by Month, of, A, Complaints (——), and B, Days for which Complaints were Received (- - -), for the period Jan. 1, 1972 to Dec. 31, 1978. (Ashbridge's Bay Sewage Treatment Plant)

b) Time of Complaint

Time of Complaint		
Time	Number of Complaints	% of Complaints
12.01 a.m. - 6.00 a.m.	2	1.5
6.01 a.m. - noon	36	24.5
12.01 p.m. - 6.00 p.m.	32	21.0
6.01 p.m. - midnight	76	53.0
	146	100.0

TABLE 11

Table 11 indicates that the majority of complaints (53%) occur between 6:01 p.m. and midnight. This could be attributed to increased operation during such a period.

c) Perception and Awareness of the Problem

Odours from the sewage treatment plant can be extremely strong and malodourous at certain times. Tolerance and perception will vary among individuals. For a discussion on tolerance and perception, see Section A4(c).

d) Socio/Economic Characteristics

Using census information from Statistics Canada, Table 12 reveals characteristics of the area surrounding Ashbridges Bay.

No major correlations or similarities between tracts were exposed. However, the various aspects of each tract are revealed. Tracts 026 and 027 produced the majority of complaints and appear to have one of the highest population densities, about 10,000 persons/sq.km.

ASHBRIDGES BAY CENSUS INFORMATION

	TRACT NUMBER															
	109	020	021	022	023	024	025	026	027	028	072	073	074	077	078	079
Population (1976)	3107	29	5623	4258	3580	7698	3361	7130	4822	5825	8789	2958	8970	4933	6228	6314
Pop. Density Sq./Kilom.	7061.36	55.7	6615.29	7885.19	5343.28	10997	6483	9506	10259	8694	9155.21	8216	9682	8221	8304	6251.49
MOTHER TONGUE																
Eng.	2245	25	4950	3710	3180	6515	2800	5260	3335	3815	5715	1980	2655	3660	5055	5245
FR.	90	5	85	45	25	105	80	160	125	120	135	40	85	115	145	110
Gr.	35	-	120	105	85	150	50	115	45	60	70	40	55	120	105	70
It.	55	-	10	35	10	125	40	130	85	80	550	140	185	195	165	205
Uk.	15	-	35	20	20	40	30	65	45	25	20	30	40	30	45	40
Other	575	5	230	220	105	470	260	1145	1065	1505	1620	640	810	680	545	530
Total Occ. Private Dwell.	840	-	2475	1555	1270	2820	1325	2275	1450	220	2465	880	1265	1620	2245	2045
Owned	570	-	905	995	885	1570	535	1460	920	1550	1530	610	875	1080	1190	455
Rented	270	-	1565	560	385	1245	790	815	530	1080	935	275	395	540	1055	590
Single Det.	75	-	395	545	715	640	215	600	275	470	565	215	355	380	620	605
Single Att.	690	-	335	355	130	845	355	935	865	305	1240	545	525	755	650	905
Apartment	65	-	1530	510	360	1115	700	650	280	1065	610	95	300	395	865	465
Duplex	5	-	210	145	70	225	55	85	30	150	50	35	90	85	110	75

TABLE 12

(i) Property Values

For discussion on property values, see Section A - 4d(iii).

5. Complaint Data

a) Types of Complaints

Complaints are strictly related to odour. Data was collected for the years 1972 to 1978, inclusive.

b) Number of Complaints

Complaint data were broken into three categories: 1) number of complaints per month; 2) number of complaint days per month; and 3) number of complaints per complainant. These categories were used to illustrate the manner in which data can be analyzed and interpreted.

Table 13 indicates how many actual days complaints were received. As indicated, many complaints are related to a specific accident or episode. Such a factor stands out clearly for the month of August, where 51 complaints were received in only twelve days.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Complaints	0	0	0	1	6	28	27	51	26	7	3	0
Days	0	0	0	1	5	15	8	12	13	5	2	0

TABLE 13

Table 14 illustrates the number of complaints per complainant for the period Jan. 1972 to Dec. 1978 inclusive, which ranges from one complaint per person to fifteen complaints for one individual.

# of Complaints	# of Complainants	Total Complaints
1	76	76
2	12	24
3	5	15
4	2	8
5	2	10
15	1	15
TOTALS	98	148

TABLE 14

Tables 15A and B, show reductions in complaints over the past years. During 1971-2, odours were caused by a variety of sources. These included:

- open door-ways;
- truck doors and windows of the grit removal building;
- incinerator buildings; grit buildings on the north side of Lakeshore Blvd. E.;
- primary and secondary aeration tanks;
- incinerator stacks during "up-set" conditions;
- fan exhaust of Oliver filters.

COMPLAINTS by Month for
Ashbridges Bay Sewage Treatment Plant

Year	April	May	June	July	Aug	Sept	Oct	Nov	Totals
1972	-	-	3	15	50	24	2	3	97
1973	-	1	-	-	1	-	4	-	6
1974	-	-	13	12	-	2	1	-	28
1975	1	4	1	-	-	-	-	-	6
1976	-	-	10	-	-	-	-	-	10
1977	-	1	-	-	-	-	-	-	1
1978	-	-	1	-	-	-	-	-	1
TOTALS	1	6	28	27	51	26	7	3	149

TABLE 15A

ACTUAL NUMBER OF DIFFERENT DAYS ON WHICH
COMPLAINTS WERE RECEIVED

Year	April	May	June	July	Aug	Sept	Oct	Nov	Totals
1972	-	-	3	5	11	12	2	2	35
1973	-	1	-	-	1	-	2	-	4
1974	-	-	5	3	-	1	1	-	10
1975	1	3	1	-	-	-	-	-	5
1976	-	-	5	-	-	-	-	-	5
1977	-	1	-	-	-	-	-	-	1
1978	-	-	1	-	-	-	-	-	1
TOTALS	1	5	15	8	12	13	5	2	61

TABLE 15B

In 1978, various measures were undertaken which caused a reduction in complaints. Reasons for such reductions include:

- more and better odour control equipment;
- 600 foot stack;
- chemical treatment;
- increase in covered sections;
- ozonation of exhaust;
- haulage of excess solids to landfill sites;
- reduction of the backlog of solids through use of the incinerators.

At the moment, most odour problems with the plant stem from poor sludge treatment. In this process finely divided, suspended and dissolved materials that remain in the wastewater are removed. This operation at Ashbridges Bay is experiencing difficulties.

Table 14 illustrates the predominance of individuals complaining only once. Reasons may include the belief that one complaint is enough, opinions that MOE can't do anything about the odours, the frequency of isolated incidents, or an increased tolerance to odours.

c) Source - Receptor Distance

Complaints related to distance were broken into two categories. Initially each complainant's address was plotted on the map and distance from the source measured. Secondly, each individual

complaint was plotted and distance measured. A general location was used to approximate source of emissions so as to provide for a conservative estimate of distance.

Percent of Complainants by Distance

DISTANCE	PERCENT	CUMULATIVE %
1 km	3	3
2 km	69	72
3 km	21	93
4 km	6	99
5 km	1	100

TABLE 16A

Percent of Complaints by Distance

DISTANCE	PERCENT	CUMULATIVE %
1 km	5	5
2 km	56	61
3 km	26.5	87.5
4 km	11	98.5
4 km	1.5	100

TABLE 16B

As indicated on Table 16, most complaints were received from within two kilometers. Few residences are located within one kilometer. The closer residents are located to odour sources, the more complaints are received, and there is increased liklihood individuals will complain more than once.

6. Discussion

Odours from the Ashbridges Bay Sewage Treatment Plant are very discernable. Problems of such odours being mixed and therefore difficult to determine were not experienced.

As previously discussed, complaints have been decreasing over the past few years. This is due to changes in operation, and an improvement in pollution control equipment.

Climatological influence requires more study. Increases in odour complaints during high temperatures are indicated. However, wind speed and direction measures were not applicable as there were no monitoring stations nearby.

7. Summary

Some tentative conclusions can be drawn concerning various factors that have been examined. Emphasis shall be placed upon those variables which can be controlled or accounted for by planning.

: Climate - For a full report concerning winds, see Section A 3b(i). If dominant wind patterns can be established, especially during summer months, consideration should be given when temperatures are high, to areas most affected by odours. Monitoring equipment would need to be increased to help establish patterns.

: Topography - As previously discussed, topography is likely to have an effect upon odour dispersal. This is especially true when sewage treatment plants are built at lower elevations than surrounding land uses.

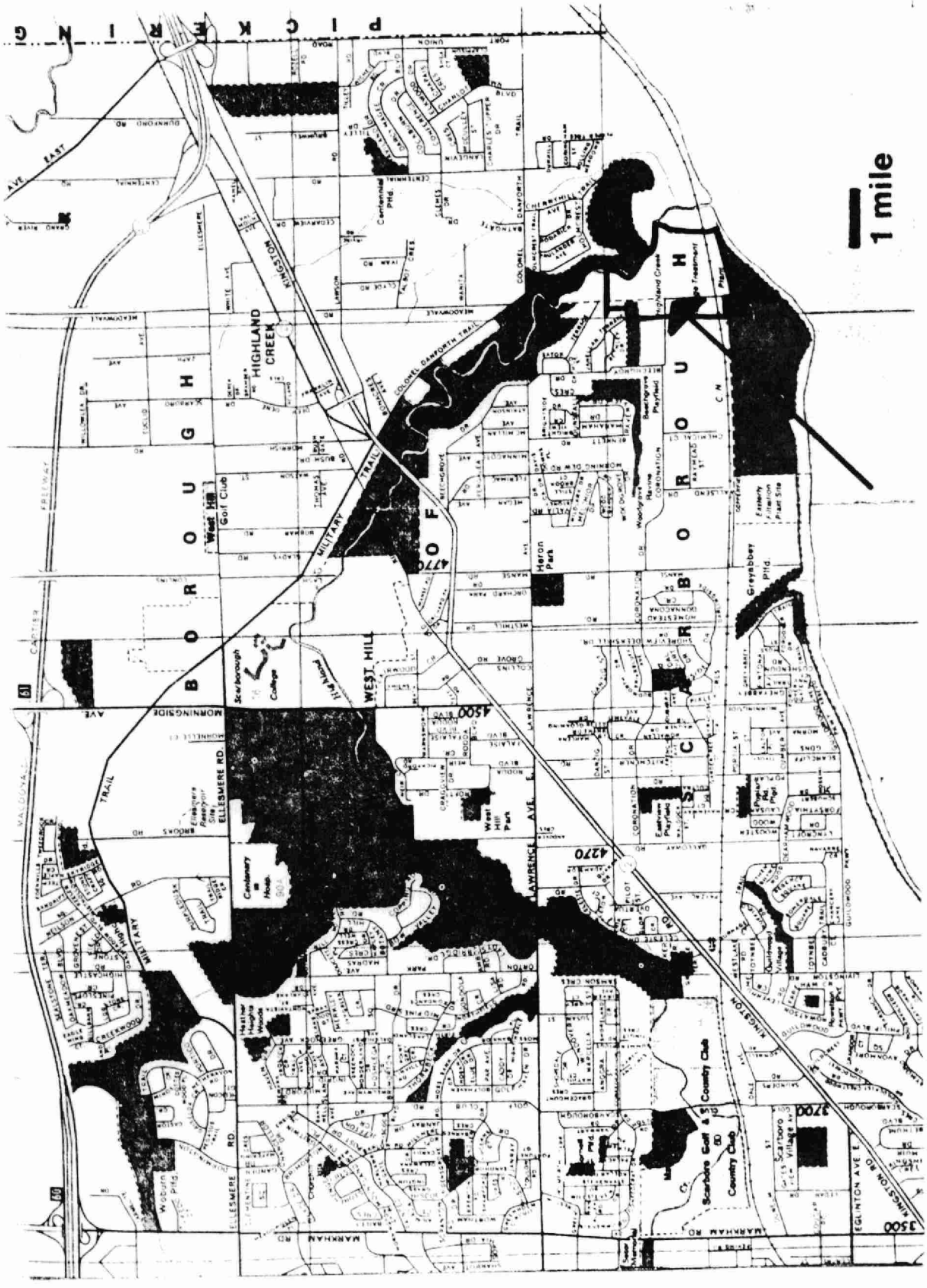
: Distance - Once again, distance appears to be the most important variable in determining nuisance from odours, even though populations are unevenly dispersed, and few residences are located within the first kilometer. Sufficient distance in the form of a buffer zone, between source and receptor would reduce odour related problems.

D. Highland Creek Sewage Treatment Plant

The sewage treatment plant is located in Scarborough, south of Lawrence Avenue East. To the north is Highland Creek Park, to the south is Lake Ontario, and residential areas surround the location to the east and west, as indicated by Map 8.

Situated in a primarily industrial area, most complaints are related to other operations, for example, a chemical plant. Highland Creek has produced only one complaint concerning odours. The complainant is located to the east.

Reasons for differences in the volume of complaints between Ashbridges Bay and Highland Creek are varied. Highland Creek is only 1/6 of the operating size of Ashbridges Bay. Therefore, much less handling of sludge is undertaken. Air treatment facilities are in full use at the Highland Creek plant.



MAP 8: Location of Highland Creek Sewage Treatment Plant

E. Beare Road Sanitary Landfill

1. Introduction

Sanitary landfill is a method of solid and, in some cases, liquid waste disposal whereby wastes are dumped in layers and covered by alternating layers of soil. As a means of solid waste disposal, sanitary landfill often presents certain advantages over other methods:

- it may be more economical than other methods, if land is available, since capital costs and start-up time are both less, and the land can be re-used following use in landfill;
- this type of operation offers almost complete disposal, compared to other methods, such as incineration or composting, which produce products requiring further treatment, including process water, flue gas, residues, etc.;
- a wide variety of materials can be accommodated, without the problems of mixing materials, as is encountered with other methods.

The economics of solid waste disposal makes it desirable to locate landfill sites near to the generation of wastes, in order to minimize transportation costs. This may result in close proximity of landfill sites and residential areas. Care must therefore be taken, through engineering and land use planning considerations, to minimize undesirable effects which may be associated with landfill operations.

2. Landfilling Operations

The Beare Road site is operated from 6:00 to 21:30 h., but dumping is allowed only from 7:00 to 18:00 h., to allow for covering and grading. These operations can be expected to produce some noise which may bother residents in the immediate vicinity.

All material arrives by truck and consists of domestic and industrial wastes. Liquid wastes were dumped here until April 30, 1978, but are no longer permitted. Semi-liquid sewage sludge is still disposed of at this location.

Decompositon of buried waste results in the production of flammable gases such as methane and odourous gases such as mercaptans. If traps for these gases have not been designed into the site, the gases may travel through the ground, seeping out at various locations where they may present the danger of explosion or very bad odours.

Pipes have recently been driven into the ground to allow some of the gases to be vented off. The presence of methane allows these pipes to function as flares, burning the odourous gases as well.

3. Sources of Nuisance

The main problems which might be expected to occur where a sanitary landfill is in operation include the following:

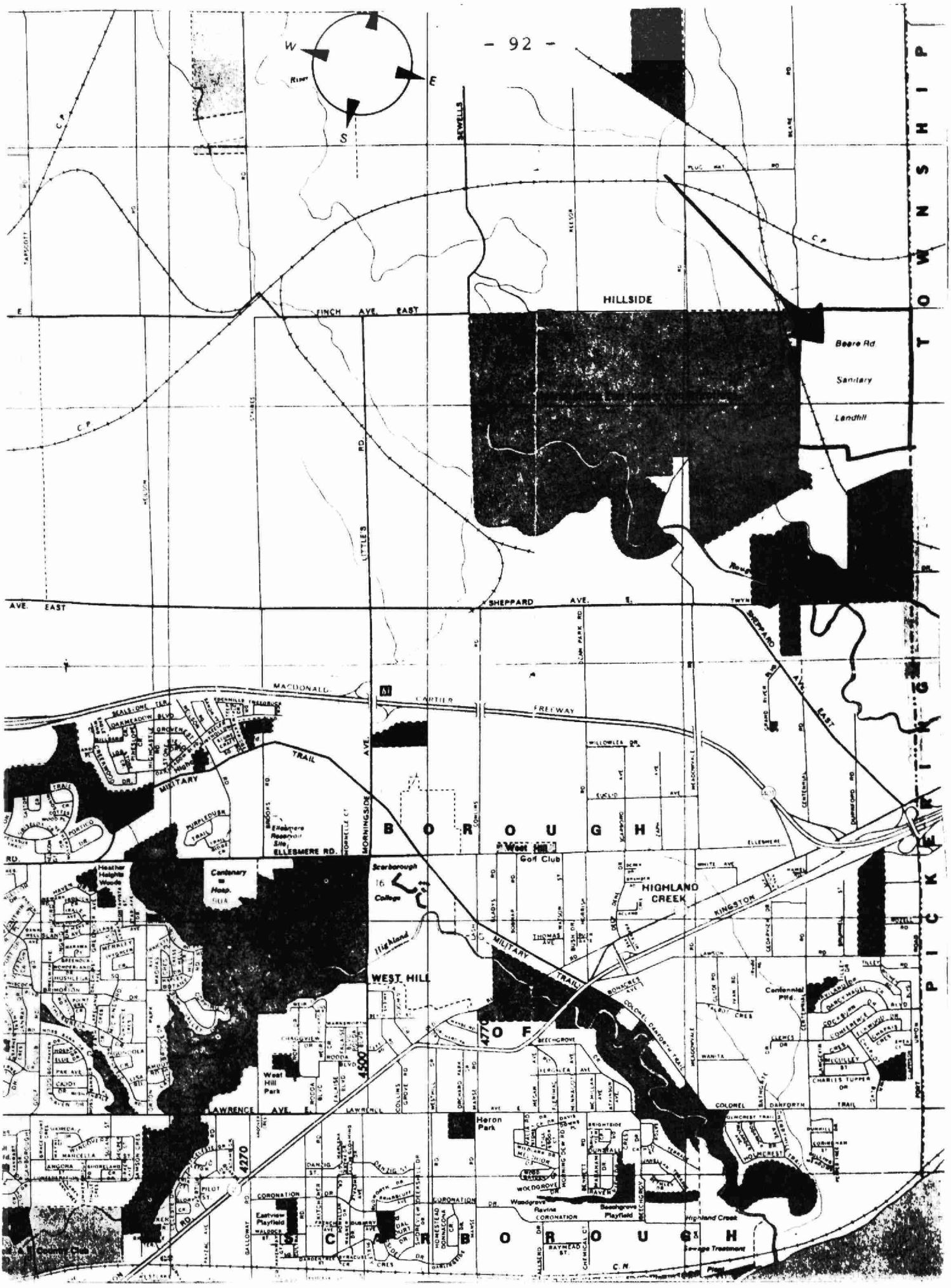
- noise, dust and odour from transportation of wastes to the site;
- contamination of ground and surface water by leachate from the site;
- noise, dust and odours from operation of the site;
- odours from gas produced during decomposition of covered waste material.

4. Description of Site and Surrounding Area

The Beare Road Sanitary Landfill Site is a 150 ha property of which half is being actively worked. The property is bounded on its northern edge by Finch Avenue East. Along Finch Avenue, within about 50 meters of the property, are a few residences, and beyond this, to the north, is flat, open farmland (See Map 9).

The western boundary of the property is Beare Road, which is intersected at a sharp angle by a railway line which crosses the southwestern corner of the property. Beyond Beare Road is farmland and then the wooded Rouge Valley and Metro Zoo. To the south, the western part of the property is approximately bounded by the rail line, and the eastern part by a hydro right-of-way. Directly south of this is farmland and beyond this the wooded Rouge Valley.

The Pickering Township line is the eastern limit of the property and beyond this there is some residential development, mostly to the southeast, beginning about one kilometer away.



MAP 9: Location of Beare Rd. Sanitary Landfill Site
Scarborough

The eastern half of the property east of the railway, between the right-of-way and Finch Avenue, is currently being operated for landfill.

The dwellings in the vicinity, which are found primarily to the east and south, for the most part appear to be modest bungalows about twenty-five years old. The area has a somewhat rural atmosphere, with a fair amount of vegetation. The landfill operation is visible from the west and north, where very few houses are located near the site, whereas the vegetation to the east makes the site invisible to the residents.

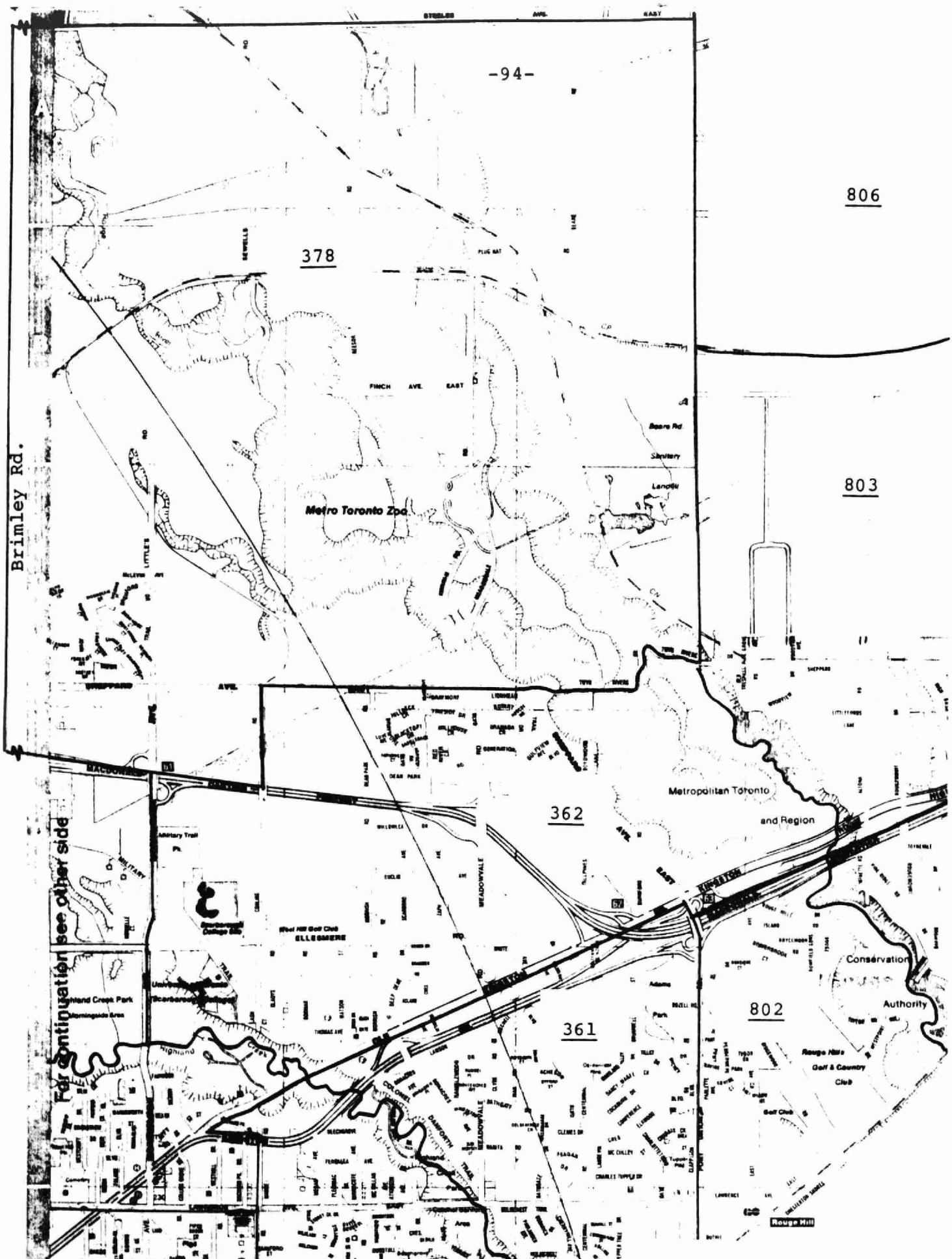
Some socio-economic data is given in Table 17, where most of the complaints reside in census tract number 803 (Map 10).

5. Climatological Factors

Climatological data were obtained from the Ministry's Air Resources Branch. Wind data from the monitoring station located at Lawrence and Kennedy Avenues in Scarborough were used to plot an average wind speed for the two-year period 1977-1978 (Figure 6).

	Census Tracts					
Tract No.	361	362	378	802	803	806
Pop. 1976	7,460	3,981	20,429	3,943	2,162	2,146
Density (Pop./sq.km.)	1,379	439	377	928	221	21
Dwellings Occupied by (1971)						
Owner	1,355	925	620	840	530	490
Tenants	135	185	180	45	90	150
Avg. Hsld. Income (1971)	14,123.	12,112.	13,725.	15,121.	11,336.	10,763

TABLE 17



MAP 10: Census Tracts

METROPOLITAN TORONTO

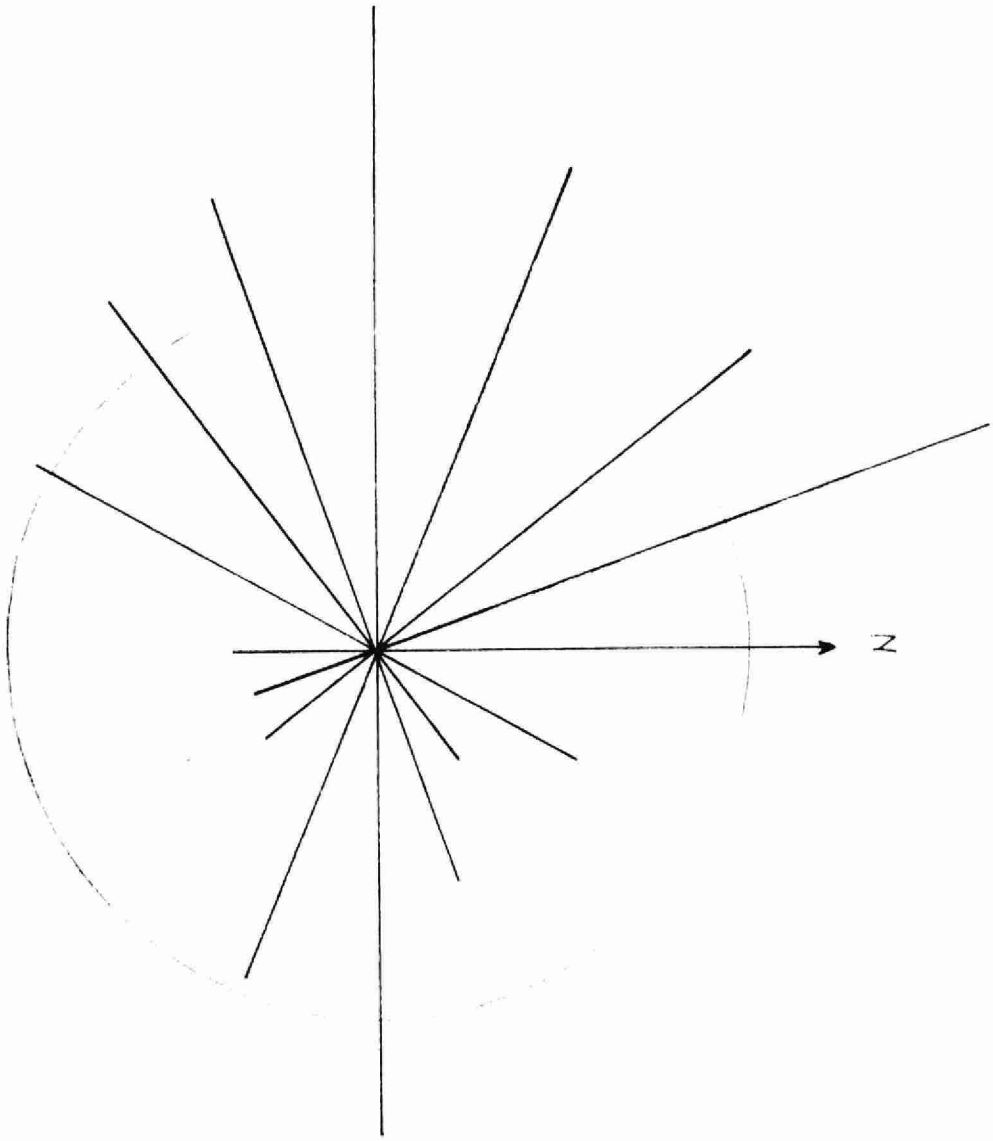


Figure 6: Wind rose for the years 1977 - 1978, data from the Lawrence and Kennedy Avenues monitoring station.

6. Complaint Data

Types and Number of Complaints

The complaint data obtained for this site differ slightly from the other sites examined in the study.

Six complaints, on the usual forms, were recorded, and all of these concerned odour. In addition, however, letters were received from 58 different addresses, describing continuous odour problems. These letters were written to discourage an extension of time allowing the dumping of liquid wastes at the site, but most of the letters emphasized the continuous exposure to very bad odours in the area. These data are not so useful in describing temporal or climatological factors, but do give a good impression of the spatial extent of malodours. Map 4 in the Appendix indicates the predominant areas of complaints from the landfill site.

Conversations with the inspector also revealed that complaints have occasionally been made regarding noise in the evening, but these are for fewer than those concerning odour. The distances of odour complaints from the site are summarized in Table 18.

Number of Complaints by Distance

DISTANCE	NUMBER	PERCENT	CUMULATIVE %
1 km	39	72	72
2 km	13	24	96
3 km	1	2	98
4 km	0	0	98
5 km	1	2	100

TABLE 18

7. Discussion

Separation distances currently recommended by MOE Regions for solid waste sites and residential areas, do not exceed 1,500 feet, and in some instances are much less. It would appear from the listed data of the Beare Road operation that 1,500 feet, or approximately 0.5 km. is insufficient, at least for an operation of this nature and this size.

The complaint data included here may well under-estimate the magnitude and the extent of the problem. The letters of complaint suggested serious problems, yet the Regional MOE files revealed few complaints. Apparently some complaints are also received on an 'informal' basis, which are not recorded in the usual manner.

F. Garbage Transfer Station

1. Introduction

Throughout Metro Toronto, garbage trucks collect domestic and commercial refuse and dump these collected materials at transfer stations. Here the garbage is compacted and reloaded onto larger trucks which then transport the material to landfill sites. Any stage of garbage handling is a potential source of odour.

2. Description of Site and Surrounding Area

This garbage transfer station is located at the south-west corner of Victoria Park and McNicoll Avenues in the City of North York. The station began operation in January, 1978. It is

a relatively large station, handling refuse which is about 87% domestic and 13% commercial in origin.

The area immediately surrounding the station is light industrial, with some residential areas located about 0.5 kilometers away. A hydro-electric right-of-way passes just south of the station, in an east-west direction. Map 11 indicates the general location of the garbage transfer station.

Topography is flat and vegetation is sparse but varied in the immediate area.

3. Complaints

Only a few complaints were received concerning odours from the station, all of these from the adjacent light industrial area. One address is directly across the street from the plant, and the other is within one-half kilometer of the site.

According to the area Municipal and Private Abatement Inspector, when the station first began operating, occupants of nearby buildings were not aware of its function and its odour potential, and therefore did not complain about it.

When it was recognized as a potential odour source, some complaints were made which later proved to be from the complainants own facilities.

MAP 11: Garbage Transfer Station at Victoria Park and McNicoll Avenues, Scarborough.

Some complaints received shortly after operations began were valid, however, as certain problems did exist, the causes of most of these problems were determined and resolved as follows:

- too much refuse was being accepted, resulting in delays in moving garbage through the station; resolved by limiting the amount of material accepted;
- refuse often remained in the station over the week-end, resulting in odours; resolved by clearing out the plant and cleaning each Friday afternoon;
- general garbage odours; reduced by installation of a fan system and the use of deodorant/disinfectant.

4. Other Factors

Due to the small amount of data, the importance of other factors cannot be determined.

Climatological factors could be expected to have some influence through effects of temperature on odour production from garbage, and of wind conditions upon the dispersal of odours. The wind rose for the Lawrence/Kennedy Avenues monitoring station can be found in the section on the Beare Road Landfill Operation.

The light industrial land use surrounding the station appears to act as a buffer between the station and residential areas. Even when odours do occur in such areas, tolerance appears to be greater than for residential areas. In fact, at least one complainant phoned in a complaint mainly to ensure that his own light industrial operation did not get blamed for producing an odour, rather than to complain of a nuisance effect.

5. Summary

The limited data available suggests that the scale of operation of garbage transfer stations is such that good housekeeping practices may be sufficient to control odours except for the most immediate area. Their placement in industrial or light industrial areas appears to be appropriate.

G. General Discussion

Source of Nuisance:

- each installation will differ with respect to emissions, dependant upon its raw materials, processes, abatement equipment, etc.
- due to various factors, such as poor housekeeping, careless operation and mechanical failures, odours will never be completely eliminated.
- different types of industry will each have their own particular problems.
- the nature and magnitude of each operation will need to be considered on an individual basis when planning for adjacent land uses.
- where several industries are grouped together, the probability of odourous emissions is increased.

Transmission of Contaminants:

- distance appears to be the most important determinant of transmission and degree of impact of odours. This information is summarized in Table 19. The 80 percent

TABLE 19: OVERVIEW OF TOTAL NUMBER OF COMPLAINTS FROM INCOMPATIBLE LAND USES AND SOURCE-RECEPTOR DISTANCES REPRESENTING ABOUT 80% OF TOTAL ODOUR COMPLAINTS

Land Use	Total Number of Complaints Over Five Years From Odour (1974 - 1978)	Approximate Source-Receptor Distance Containing 80% of Total Complaints
Gulf Oil Refinery (Mississauga)	678 (942 with other adverse effects)	1.5 km.
Shell Oil - BP Refinery (Oakville)	184 (total 259 considering other adverse effects)	2.5 km.*
Ashbridges Bay Sewage Treatment Plant	150	2.5 km.
Meat Packing Houses (13 near Keele - St. Clair Avenues)	18	1 km.
Gordon Young Rendering Operation	9	1.5 km.
Garbage Transfer ** Station (Victoria Park & McNichol Ave.)	8	1 km.
Beare Road Land-fill Site	7 (over 100 on one petition)	1.5 km.
Darling & Co. Rendering Operation	2	.5 km.
Highland Creek Sewage Treatment Plant	1	1 km.

* Only a few people living within one kilometer.
** In operation since January, 1978.

distance is somewhat arbitrary and is used here for comparative purposes. However, complaint studies done for the Nanticoke air pollution buffer zone around oil refineries and steel mills by the MOE's Air Resources Branch indicate that this 80% level is close to the point where the reduction in complaints is maximized in the minimum distance away from the emission sources.

- intervening objects such as berms, buildings and vegetation are useful in reducing visual and noise impacts, but are less effective for reducing malodours. (although there may be a psychological influence involved).
- wind can be expected to influence the spread of odours at any given time, however, the wind may blow in any direction for a comparable period of time or in several directions in a short period of time; therefore, the relevance of wind direction to planning for land use compatibility is uncertain.
- atmospheric conditions will likely make more severe those odours caused by occasional upsets and breakdowns, whereas the effects of low-level nuisance odours caused by day-to-day operations may be less dependant upon such factors.
- special topographic features will need to be considered on a case by case basis.

Receptors:

- the subjective nature of odours make malodours particularly difficult to evaluate.
- many factors effect individuals' perceptions of and reactions to odours.

- uneven distributions of receptors should be accounted for by using standardized measures (e.g. complaints per thousand households) in future studies.
- complaint data alone may understate the magnitude of a problem.

CHAPTER 4

CONCLUSIONS AND RECOMMENDATIONS

1. Complaint Analysis Is Potentially Useful For Land Use Planning and Should Be Continued In Particular Situations

Complaint analysis is useful in providing factual and quantitative data to substantiate planning control measures, such as separation distances, which can maintain land use compatibility. Many factors may influence the nature of the complaint data used, and many of these are not fully understood (See Chapter 3, A-6). Although the complaint files used are the only currently available source of data for this purpose, they assist in identifying some of the factors involved in land use compatability, and with more data extracted, will help in understanding important relationships between land use compatibility factors.

Recommendation: It is recommended that the method of complaint analysis be continued in Ontario for testing its applicability to land use planning. The most ideal situations for collecting and analyzing complaint data are for those pollution sources which have large numbers of seasonally available complaints occurring in a fairly even distribution around them. Additional complaint data should be collected from the following sources:

- the same, large-scale sources examined in this study, such as oil refinery operations, Sarnia;

- those emission sources not studied but similar in physical size to the large-scale operations examined, including steel mills and automobile foundary operations with extensive complaint histories;
- other sources of odour emission, such as pig farms, which would allow comparison of levels of odour protection that have already been established through Minimum Distance Separation (MDS) formulae calculations (i.e. Agricultural Code of Practice).

2. The Method of Complaint Analysis First Requires Refinement to the Rationale for Properly Defining Adequate Levels of Protection Consistent with Costs and Benefits. Identifying What The Complaint Data Actually Represents With Respect to Numbers of People Potentially and Actually Affected Also Requires Refinement

Certain aspects of the method must first be refined before starting any further data collection or future research.

Recommendation: Develop further the rationale for selecting an appropriate level of protection (e.g. separation distance based on eliminating 80% of complaints) that is based on minimum cost (e.g. size of separation distance) and maximum benefit (e.g. most number of complaints eliminated).

Recommendation: Determine how representative the complaint analyses are with respect to those residents that are known to be affected, and the number of those residents that are potentially affected. Estimating the percentage of those

residents that were affected by odours and other nuisance environmental effects and actually complain to the Ministry of the Environment, can be estimated for oil refineries by comparing the complaint data with the questionnaire responses assembled in the Clarkson Community Survey around the Gulf refinery, Mississauga.

Estimating how representative the complaint data is with respect to the total number of persons that could potentially be affected, can be determined by relating number of complaints to relative population densities in the affected areas. This can be achieved by estimating population numbers in the affected areas, various distances away from the pollution source by counting number of residences on municipal street maps and using local household occupancy figures from Ontario Statistics, converting residences to persons. These figures can then be compared with the number of complaints within the zones.

3. <u>The Most Useful Factor In Applying Complaint Data To Land Use Planning Is Source - Receptor Distance. Climatological Conditions Could Affect the Sizes of these Distances and the Effect that "Sight-Lines" Between Incompatible Uses Have on Complaints Should Be Examined.</u>

Source - receptor distance is the most important factor that can be used in land use planning for minimizing the adverse effects of odour emissions or other nuisance effects on residential areas. There are many other variables involved in land use compatibility in addition to separation distance, that could be

used as planning control measures. These include: minimizing exposure of high densities of people involved in sensitive activities (e.g. sleeping) to objectionable environmental conditions by using compatible intervening land uses, topographic and vegetation screening, and, as a last resort, warning clauses to future residents on title, deeds or leases. It is difficult to quantify or even approximate the effectiveness of these measures using complaint data.

Recommendation: It is recommended that existing climatological data from monitoring stations near to the Shell/BP and Gulf Oil refineries, especially wind direction and speed, be compared with the locations and numbers of complaints during complaint episodes, to determine what climatic conditions are important in contributing to sites of severe adverse conditions. Consideration should be given to how wind direction and speed affect the size of separation distances.

Although insufficient information exists to specify the degree of importance to planning of these other factors, it would appear that climatological variables, such as wind direction and speed (humidity, temperature, etc.) can exert considerable influence upon the transmission of contaminants.

Recommendation: It is also recommended that the available complaint data be examined for the significance of how "sight-lines" between incompatible uses may increase the incidents of complaints, and therefore could be used as a design measure.

4. Ministry Of The Environment Complaint Handling Procedures Are Adequate For Using Complaint Data In Land Use Planning, But Require Continued Care in Recording.

The manner in which complaint information is currently recorded and filed by the Ministry of the Environment Regional and District Offices is adequate for this type of analysis.

Recommendation: The current procedure for the handling of complaints should be continued, but requires continued care in order to ensure that:

- all complaints are immediately recorded on proper complaint memos and filed (according to the source of emission);
- all relevant information is recorded (e.g. street address, kind of environmental contaminant, time, physical disorder experienced, etc.);
- complaints are followed-up quickly by the abatement inspector (to confirm the emission and verify the cause), and the results of the investigation are fully recorded in the file.

In addition, for the purposes of complaint analysis, a daily log of complaints, for each source, would be useful for future complaint analyses to ensure that complaint information was complete, and to hasten the data collection process.

5. Future Research Should Be Undertaken In Several Areas:

5.1 Quantifying Receptor Characteristics Useful As Planning Control Measures and as an Indication of the Actual Number Of Affected Residential Occupants Who Have/Have Not Complained.

Census data from Statistics Canada gave only a general descriptive picture of the socio-economic characteristics of receptors (complainants). It could not be correlated in a quantitative sense with the complaint data. However, other physical characteristics of complainants and their residential properties may be useful to planning.

Recommendation: It is recommended that a future study should be undertaken in the form of a questionnaire survey of communities affected by adverse environmental effects, such as odour. It would be compiled so as to clearly show what the complaint data actually represented as far as what percentage of the people actually affected complain and, the data's usefulness for planning control measures. It might give some indication of what percentage of the population affected actually does/does not complain, and what characteristics of the receptor might be useful as planning control measures, such as property design features which interupt visual sight-lines between the emission source and residential properties.

Another factor which could also be explored is length of residence, to examine if well-established residents in an area complain more than new residents, or to see if residents who have lived in an area before the introduction of an obnoxious industry are more likely to complain more than others.

Evaluating the use of the community study as an alternative to complaint analysis should also be examined.

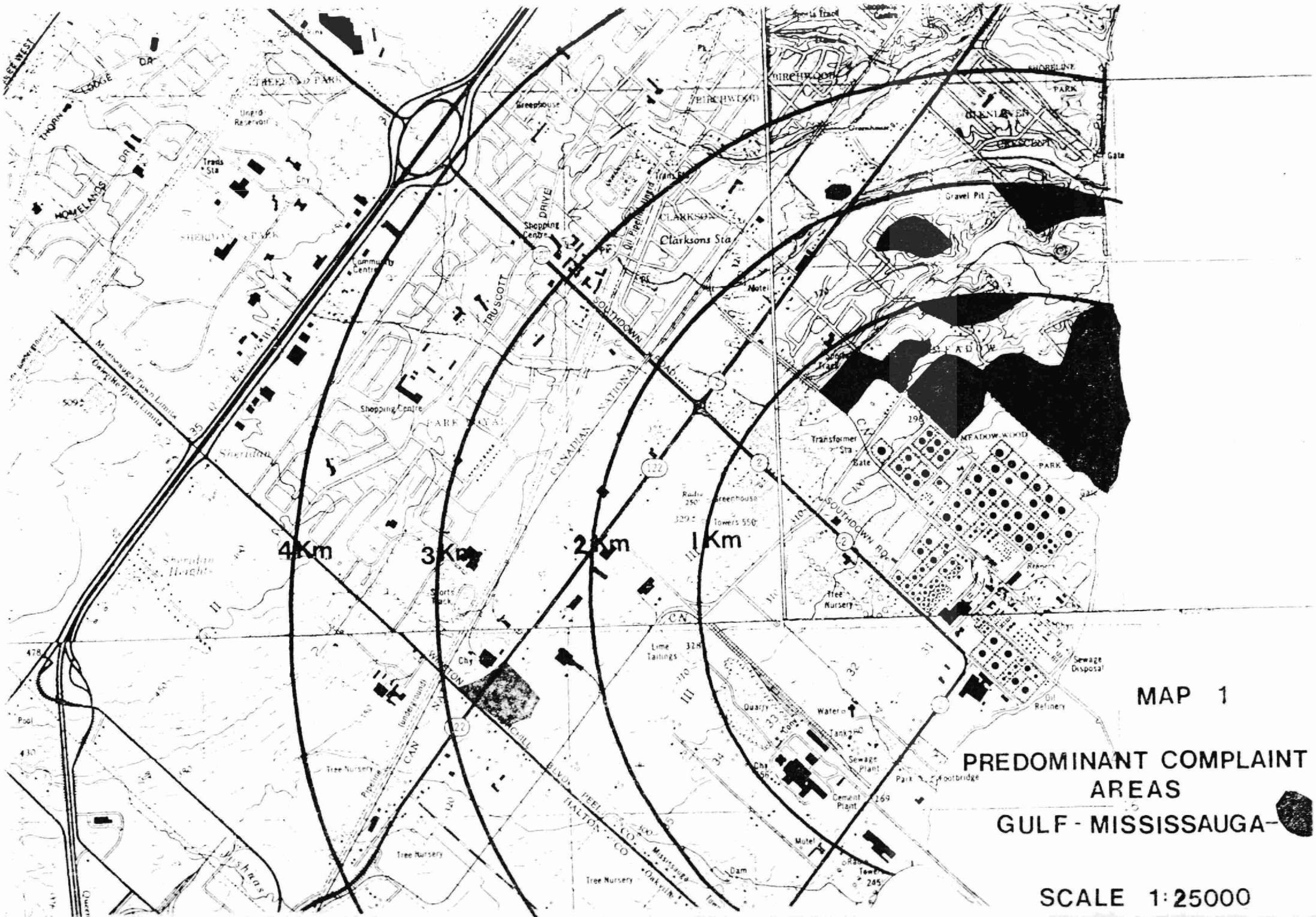
5.2 Quantifying Odour Dispersion Characteristics With Climatic Factors

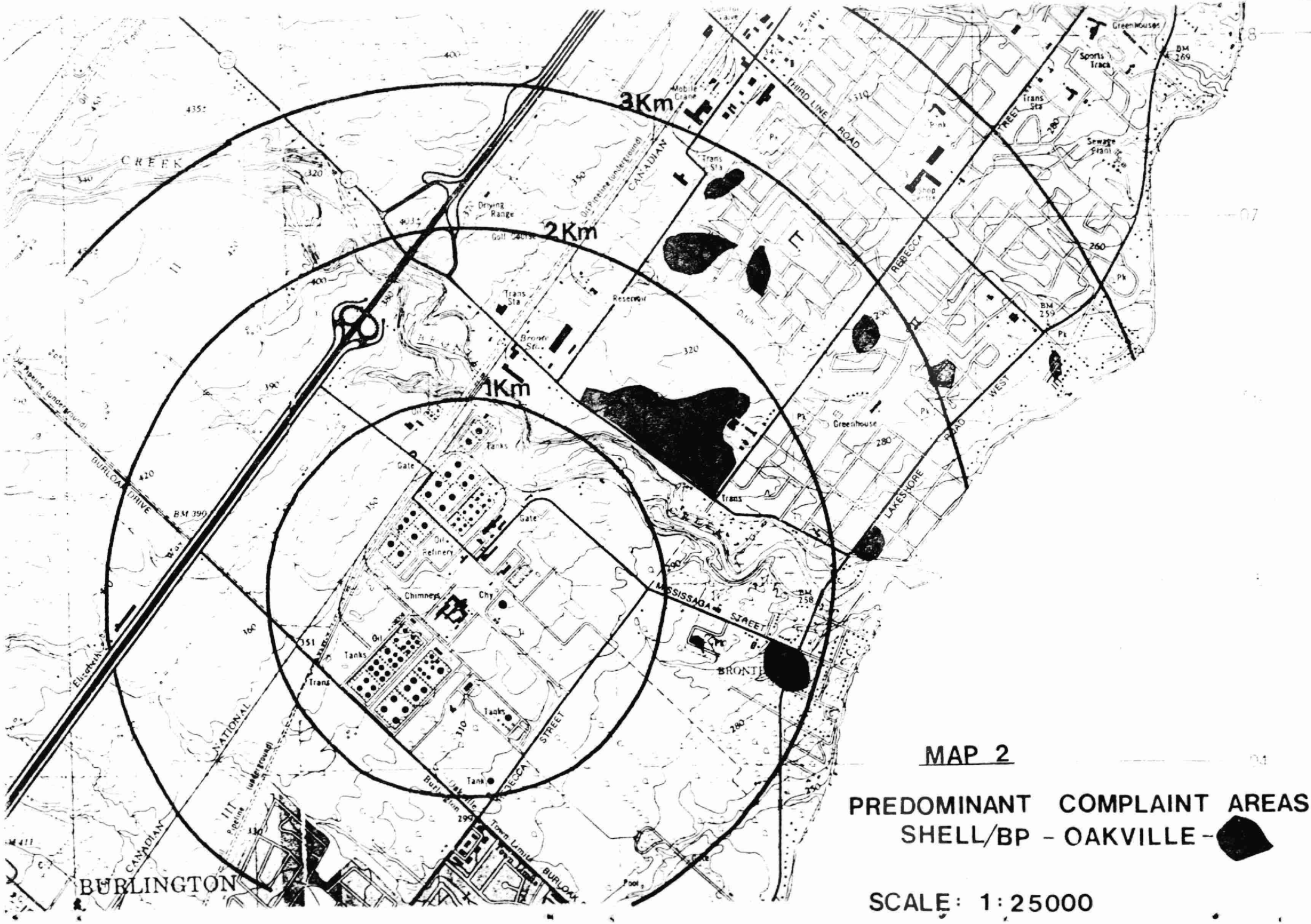
Little is known about how climatological factors, such as wind direction and speed, humidity and temperature, affect the dispersal and transmission of odours. Even if these relationships were known, there are problems with not having sufficient numbers of air quality monitoring stations in proximity to the source of emission and near to the affected residential areas to be able to adequately simulate nuisance conditions.

Recommendation: It is recommended that further investigations be undertaken to better understand how the dispersion of odours is influenced by climatic variables, such as wind direction and speed, humidity and temperature.

Recommendation: Consider ways and means of establishing more air quality monitors in sites close to both the source of emission and the affected residential areas, so as to more reliably simulate the effects of climate on odour dispersion, in a cost-effective manner. One approach may be to explore the feasibility of equipping residents bothered by periodic odours with odour sampling kits, and requesting that samples be taken during each odour episode. This would not only build upon data for quantifying objectionable odour levels at various distances from emission sources, but may also provide a psychological outlet for community complainers. This program could be analogous to the Ministry of the Environment's Cottagers' Self-Help Program.

APPENDIX

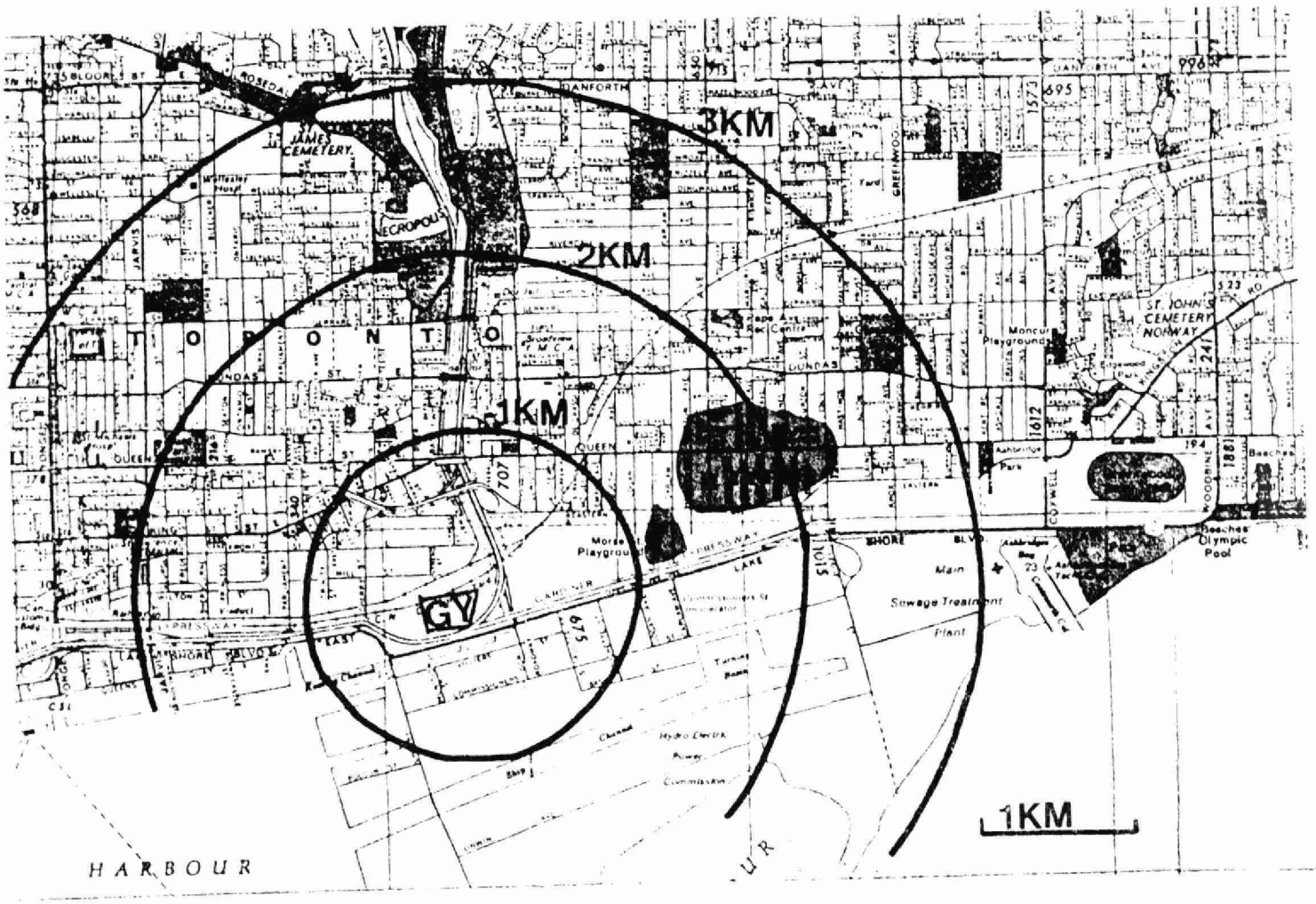

4Km
3Km
2Km
1Km
MAP 1
PREDOMINANT COMPLAINT AREAS
GULF - MISSISSAUGA
SCALE 1:25000



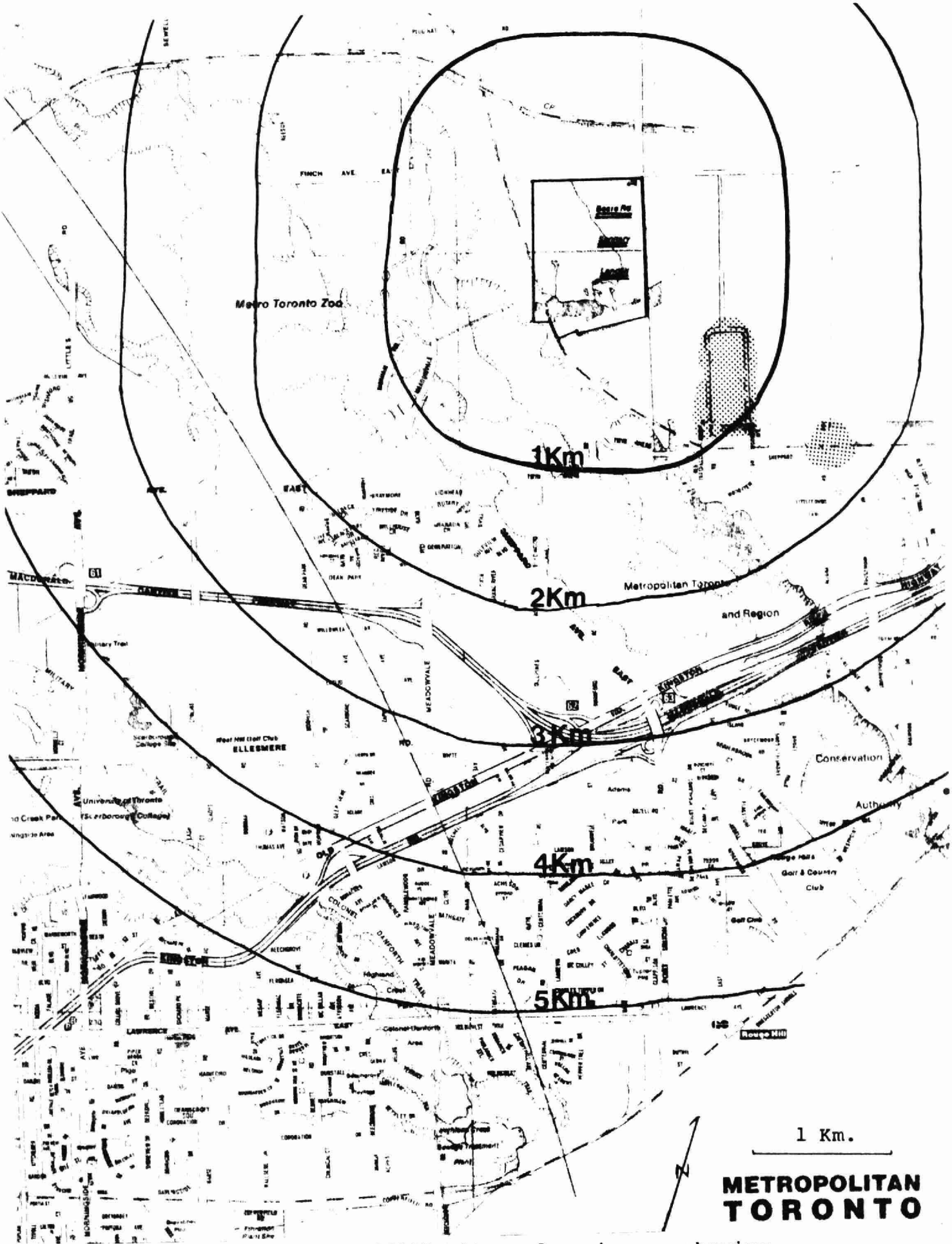
MAP 2

PREDOMINANT COMPLAINT AREAS
SHELL/BP - OAKVILLE -

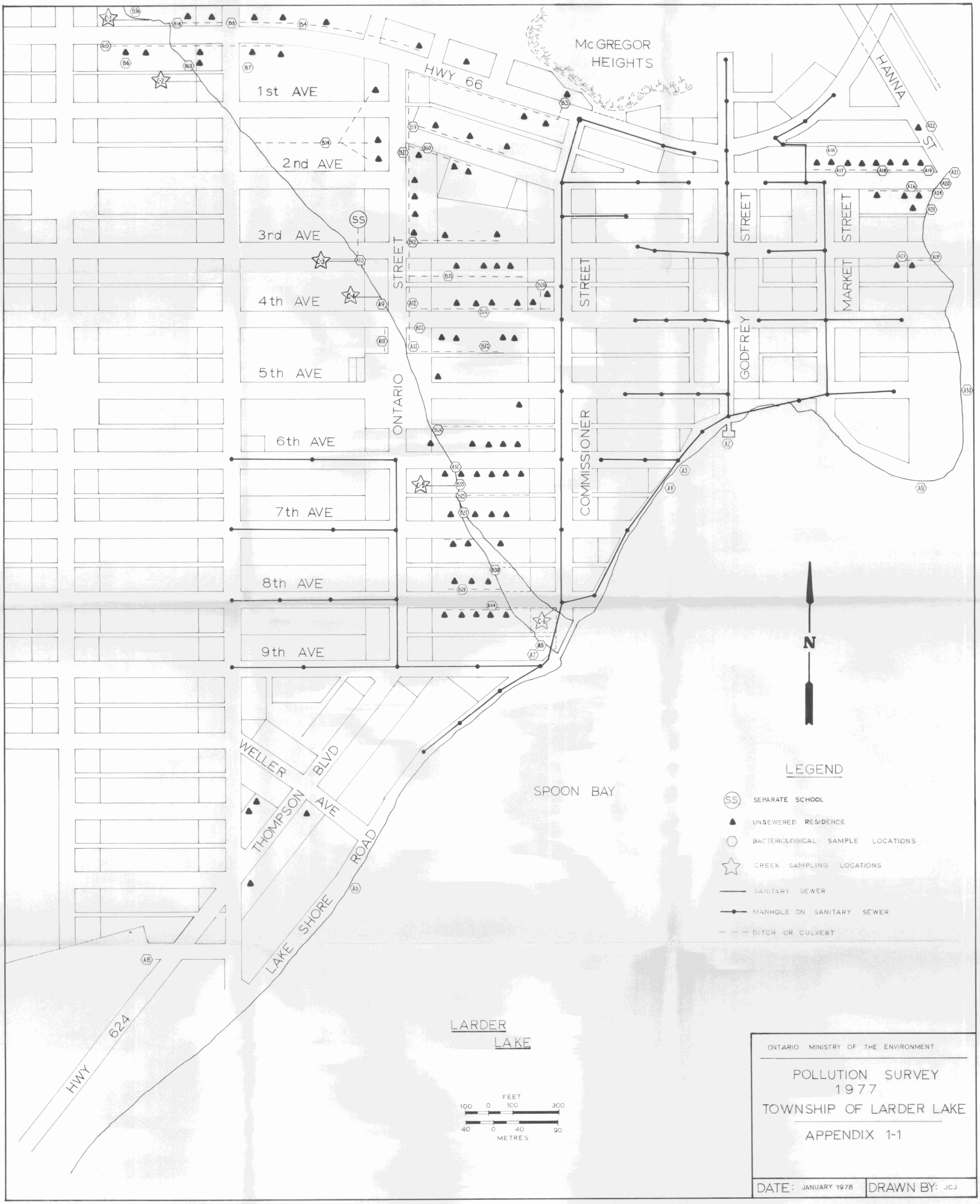
SCALE: 1:25000



MAP 3: Predominant Complaint Areas--Gordon Young
June 15, 1979 Incident



MAP 4: Beare Rd. Landfill Site and environs, showing Predominant Complaint Areas-



ONTARIO MINISTRY OF THE ENVIRONMENT

POLLUTION SURVEY 1977 TOWNSHIP OF LARDER LAKE

APPENDIX 1-1

DATE: JANUARY 1978 | DRAWN BY: JCJ